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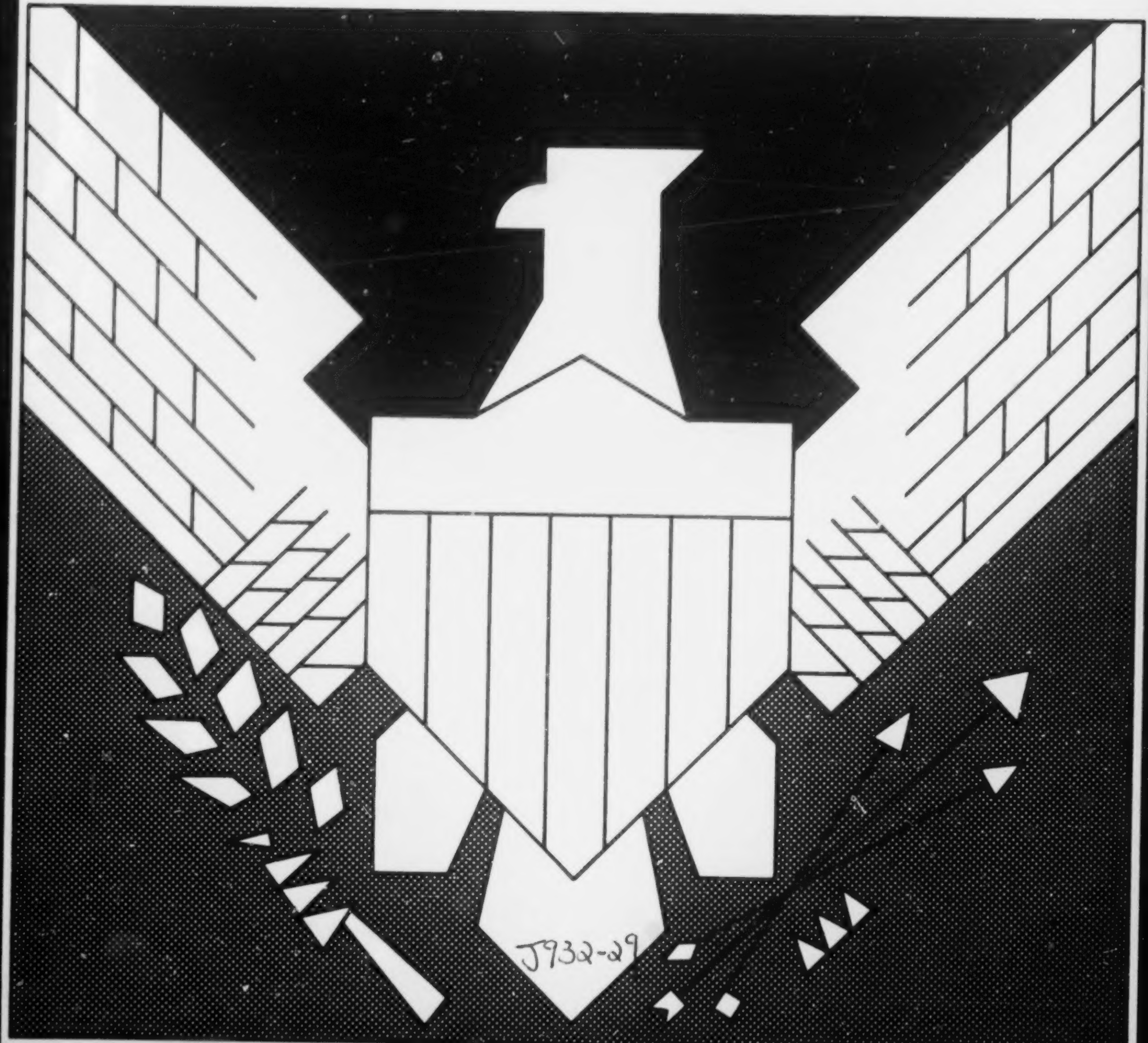
Naval Combat Aircraft: Issues and Options



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CBO STUDY

NAVAL COMBAT AIRCRAFT:

ISSUES AND OPTIONS

The Congress of the United States
Congresssional Budget Office

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NOTE

All years referred to in this report are fiscal years unless otherwise indicated.

Details in the text, tables, and figures of this report may not add to the totals because of rounding.

All costs are expressed in fiscal year 1988 dollars of budget authority, using the Administration's January 1987 economic assumptions, unless otherwise noted.

PREFACE

The Navy's plans for its combat aircraft have been a topic of Congressional debate for many years. This year, for example, the Congress debated whether the Navy could afford to purchase two new aircraft carriers while also funding its plans to modernize and increase the number of its combat aircraft. Over the next few years, the Congress may need to make reductions in proposed Navy budgets, which could heighten concerns about the affordability of these plans. Faced with severe budgetary limits, the Congress will make decisions about funding for combat aircraft that will determine the size and capability of Navy and Marine Corps air forces through the mid-1990s. Longer-term decisions about development of two new aircraft will influence force size and composition into the next century. This analysis by the Congressional Budget Office (CBO) analyzes the effects of the Administration's plans for the Department of the Navy's combat aircraft, as expressed in the President's budget for fiscal years 1988 and 1989, but does not reflect ongoing Congressional action. The report also discusses alternatives that would hold down budgets. The study was requested by the Senate Committee on Armed Services. In keeping with CBO's mandate to provide objective analysis, the study contains no recommendations.

Lane Pierrot of CBO's National Security Division prepared the study under the general supervision of Robert F. Hale and John D. Mayer, Jr.; William P. Myers of CBO's Budget Analysis Division provided extensive costing assistance and helped structure the alternatives. The author gratefully acknowledges the contributions of William M. Kostak, Richard L. Fernandez, Jack Rodgers, and Marvin M. Smith of CBO, and Dov S. Zakheim of Systems Planning Corporation. (The assistance of external participants implies no responsibility for the final product, which rests solely with CBO.) Sherry Snyder edited the manuscript. Rebecca Kees and Kathryn Quattrone prepared the final report for publication.

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November 1987

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SUMMARY

Improvements in the U.S. naval forces are the centerpiece of the current Administration's conventional defense policy. The Navy will soon have 600 ships, including 15 deployable aircraft carriers. According to the Administration, a naval force of this size is needed in a major European war to seize control of the northern Norwegian Sea, provide support to the defense of northern Norway, and also make the Soviet Union withhold forces that might otherwise be used against convoys involved in the resupply of Europe. The Navy refers to this approach as its forward offensive strategy. In addition, aircraft carriers are deployed worldwide in peacetime to carry out U.S. military objectives.

While the Navy has already bought the ships to achieve a 600-ship Navy, it has not--based on its own planning factors--bought enough aircraft to meet the requirements of its 15 carriers. Even its current five-year plan would not alleviate the shortfalls in aircraft--the difference between the Navy's stated requirements and its aircraft inventories. This suggests underutilization of expensive aircraft carriers in wartime. Moreover, that plan calls for average real growth in aircraft procurement costs of 7 percent a year from 1987 through 1992, while the latest Congressional budget plan calls for three years of real declines in overall defense spending. Thus, the Navy faces difficult choices as it attempts to procure enough aircraft within severe budgetary limits.

ADMINISTRATION'S PLAN

Over the next five years, the Administration plans to purchase about 1,085 naval combat aircraft. (Combat aircraft are those whose missions might bring them under enemy fire in war. Naval combat aircraft include those for the Marine Corps as well as the Navy.) The five-year program includes the introduction of two new aircraft: a long-range aircraft for antisubmarine warfare (LRAACA), and the V-22 aircraft to improve the Marine Corps' ability to transport personnel and equipment from ship to shore. The plan also includes major modifications to two planes--the F-14 fighter and the A-6 bomber--to increase their capabilities. All of these plans are consistent with the President's budget for fiscal years 1988 and 1989 and do not reflect ongoing Congressional action.

Aircraft Shortfalls

Despite this procurement, the Navy will be short of its requirements for aircraft. The shortfall will increase from about 110 aircraft in 1987 to 176 aircraft by 1994, the first year when all aircraft bought over the next five years will have been delivered.

Shortfalls are best viewed as a measure of how fully carriers are being utilized. The Navy argues that shortfalls of 176 aircraft need not cause carriers to be deployed without a full load of aircraft. Time devoted to maintenance and other support could be reduced, and planes returning from deployment could immediately be transferred to deploying units. Such actions, however, though probably feasible in peacetime, would reduce the Navy's capability during a major war.

Moreover, these shortfalls could be much larger. The Navy expects to modify some aircraft so that it can retain them longer. If, despite these modifications, the Navy is unable to extend service lives, shortfalls might increase to about 600 aircraft by 1994. Indeed, shortfalls may increase, since the estimates above assume that the Navy can retire many of its planes at ages older than current retirements for the last generation of aircraft.

Aging Aircraft

Naval combat aircraft will also increase in age over this period--from an average of 12.2 years in 1987 to 12.9 years by 1994. Quantifying the operational implications of an aging fleet is difficult. The Navy has argued in the past that an older fleet is less capable and harder to maintain, but it now argues that some of these problems can be overcome by modifying the planes to keep them in service longer. Nonetheless, this aging trend could present problems since the force has already exceeded several earlier Navy goals for the average age of its aircraft.

Cost

Even though it leads to an aging fleet and shortfalls, the Administration's planned funding for naval aircraft--including both combat aircraft and other types in the so-called APN (Aircraft Procurement, Naval) account--would increase from $10 billion in 1987 to $15.7 billion by 1992. After adjusting for inflation, this amounts to real growth averaging 7 percent a year. That growth comes at a time when the latest Congressional budget resolution calls for average annual real declines in total defense spending of as much as 2.4 percent for the three years covered by the resolution (1988-1990).

ALTERNATIVES TO THE ADMINISTRATION'S PLAN

In light of fiscal problems and shortfalls of aircraft, the Navy faces two difficult choices:

- How many carriers should be maintained; and
- Should costs be held down by reducing procurement of current aircraft or by delaying or canceling new programs.

The Navy can attempt to maintain its planned numbers of 15 deployable aircraft carriers and their accompanying 14 wings of aircraft. But if aircraft funding experiences little growth or even declines, the Navy would almost certainly be unable to meet all its aircraft requirements. Instead, the current shortfalls would persist and might increase, suggesting underutilization of assets, especially in wartime. Moreover, if the Navy scales back procurement for most of its aircraft lines to cut costs, and delays retirement of older aircraft to maintain a constant number of planes, it will have an older force and will pay higher unit costs for the planes it buys. Instead, the Navy could minimize this aging and increase in prices by forgoing for some years the benefits of new aircraft programs--such as either the V-22 program for the Marine Corps, a planned upgrade to the A-6 aircraft, or the Navy's planned long-range aircraft for antisubmarine warfare--and by continuing to buy existing aircraft at planned rates. (Delaying or canceling the programs would imply some restructuring of the priorities accorded various missions.)

Alternatively, in the face of budget stringency, the Navy could retain only 13 aircraft carriers in the 1990s--that is, one more carrier than it had in 1980, but two fewer than the 15 carriers it plans to have--and 12 air wings. The shortfalls discussed above would be reduced or eliminated, since requirements would be reduced by the number of aircraft associated with two air wings. Thus, the 13 carriers could be fully supported with aircraft. The smaller number of aircraft carriers and air wings, however, would decrease the Navy's ability to pursue the forward offensive strategy in war and would decrease the number of carriers available for peacetime deployment.

The Summary Table shows four options that underlie these conclusions and compares them with the Administration's plan. For the sake of illustration, each option is designed to achieve sufficient savings so that if all savings were applied to the aircraft procurement account, it would not grow in real cost over the next five years. The first two options maintain the Navy's plan to have 15 carriers, but they cut costs either by pro rata reductions in procurement of current aircraft or by delaying new programs. The second two options retire older aircraft carriers early and so provide for only 13 carriers. Savings from early retirements lessen the need to reduce procurement, but those saving that are needed are again achieved either by pro rata reductions or by delaying new programs.

LONG-TERM CONSEQUENCES OF THE ADMINISTRATION'S PLANS

Difficulties associated with procurement of naval aircraft may last beyond the next five years. In the 1990s, the Navy plans to begin procurement of two new planes for its fighter and attack forces: the Advanced Tactical Aircraft (ATA) and a variant of the Air Force's Advanced Tactical Fighter (ATF). These new planes are intended to replace the A-6 attack aircraft and the F-14 fighter/interceptor, respectively.

If its aircraft budget grows at an average real rate of 3 percent a year for the next 20 to 30 years, the Navy should be able to buy large

SUMMARY TABLE. COMPARISON OF THE ADMINISTRATION'S PLAN AND ALTERNATIVES

Plan/ Alternative	Number of Carriers	Net Aircraft Shortfall (Overage) in 1994	Average Age of Naval Combat Aircraft in 1994 (In years)		Range of Increase in Unit Costs Above Those in Administration's Plan, 1988-1992 (In percents)	Decrease in Number of Aircraft Bought 1988-1992 Relative to Administration's Plan
			All Aircraft	Fighter/ Attack		
Administration's Plan, 7 Percent Real Growth	15	176	12.9	10.3	n.a.	n.a.
Zero Real Growth Alternatives						
Option I: Reduce Procurement Evenly; Delay Retirements	15	361	14.2	11.4	7 to 82	306
Option II: Delay V-22 Three Years; Cancel A-6F Modification	15	216	13.6	10.6	n.a.	118
Option III: Reduce Force Structure; Reduce Procurement Evenly	13	(2)	13.4	10.6	2 to 12	81
Option IV: Reduce Force Structure; Cancel A-6F Modification; Delay LRAACA	13	(52)	13.3	10.4	n.a.	36

SOURCE: Congressional Budget Office using data from the Department of the Navy.

NOTE: n.a. = not applicable.

quantities of these planes and meet its long-term numerical requirements, though only if its projections of the costs of the new aircraft prove to be accurate. (While 3 percent per year may appear optimistic in the near term, it was selected to reflect projections of growth in the gross national product (GNP), thus keeping defense spending at a constant share of GNP over the long term.) In fact, at the lowest projected costs, the Navy could buy 25 percent more aircraft than its requirements call for, suggesting some room for error.

These projections of cost, however, bear little resemblance to historical patterns of growth in real costs of fighter and attack aircraft. Historically, cost increases from one generation of aircraft to the next have ranged upward from 150 percent, whereas the Navy's current estimates range from 0 percent to 60 percent. Substantial shortfalls relative to requirements, or pressure for increased funding, could occur if the ATA and Navy ATF development programs experience historical patterns of cost growth. In fact, the Navy might be able to support only about 50 percent of its requirements under some historical patterns. Although many highly uncertain assumptions underlie these findings, there seem to be as many assumptions that lead to more pessimistic results as there are assumptions that make it more likely that the Navy will meet its numerical requirements for aircraft.

It may seem absurd to worry about naval aircraft requirements so far in the future, but critical design decisions that determine costs of both these planes are being worked out now. If the Congress waits until the planes are initially fielded in the 1990s, costs per plane will have already been largely determined. Instead, as it has done in the case of the Air Force's new Advanced Tactical Fighter, the Congress may wish to place a cap on costs for these new Navy aircraft.

CHAPTER I

INTRODUCTION

The Department of the Navy (DoN), which includes the U.S. Marine Corps, currently has about 3,650 combat aircraft. These aircraft operate off aircraft carriers as well as from land bases and are deployed worldwide. The aircraft accomplish a wide variety of tasks. Some are designed to strike land targets; others protect ships or land targets from enemy attack, transport Marines ashore in amphibious assaults, or provide support functions such as electronic surveillance. Along with combat aircraft in the Air Force, these planes play an important role in U.S. defenses.

The Navy plans to expand modestly the number of its naval aircraft in coming years, consistent with its plans to increase the size of its fleet to 600 ships, including 15 deployable aircraft carriers. At the same time, the Navy plans to modernize many types of naval aircraft. (The term "naval aircraft" in this report refers to aircraft in both the Navy and Marine Corps.)

Procuring naval aircraft to expand and modernize forces is expensive. Total DoN aircraft procurement in 1987 amounted to $10.0 billion, which included costs of combat aircraft, trainers, auxiliary aircraft, modifications, and spare parts. About $5.9 billion of the $10.0 billion paid for procurement of the 11 types of combat aircraft that are the focus of this study.

By 1992, the last year of the Department of Defense's (DoD's) current five-year plan, the Administration plans to buy 10 types of combat aircraft, with total aircraft spending of $15.7 billion. After adjusting for inflation, this plan will result in an average annual real increase in total aircraft spending of 7 percent. This large planned increase in cost has heightened concern over a number of issues including the adequacy, balance, efficiency, and affordability of aircraft procurement.

Is Procurement Sufficient?

Some Members of the Congress are concerned that, despite planned spending increases, the Navy may not be procuring enough aircraft to meet its force requirements. They question the utility of maintaining 15 deployable aircraft carriers in the absence of enough planes to fill them.1/ As this paper will discuss, planned Navy aircraft inventories will fall short of the Navy's own stated requirements in each of the next seven years. That shortfall could be large under some assumptions about such factors as the age at which aircraft are retired.2/ Other assumptions, however, could lead to relatively small shortfalls that the Navy argues are manageable.

Is Procurement Balanced?

The House Committee on Armed Services has expressed concern that the Navy is buying too many of some aircraft and not enough of others. Partially for this reason, the committee canceled funding for one of the Navy's aircraft, the AV-8, and increased funding for several others (among them, the EA-6 and F-14). The Senate Committee on Appropriations shares this concern about the mix of aircraft types.

Are Navy Aircraft Being Procured at Efficient Rates?

The Congress has repeatedly expressed concern that the Navy procures too many different kinds of aircraft, making it financially impossible for the service to procure any of them in large quantities. Although it would be difficult for the Navy to support its diverse missions without procuring many different kinds of planes, under the Navy's current five-year plan three combat aircraft lines are being procured at less than minimum economic rates as defined by the Department of Defense (DoD), leaving eight of the eleven lines to be

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1. The Navy will actually have 16 carriers, but one will be undergoing such an extensive overhaul that it could not be deployed for many months.

2. "Shortfall" is the term used to describe the difference between the number of aircraft the Navy deems necessary to fulfill its missions and the number of aircraft in its inventory.

procured at or above minimum rates during the period.[3] And, over the past five years, average procurement rates for naval combat aircraft amounted to only 35 percent of the rates that plant capacity for those planes would allow.

Are the Navy's Aircraft Plans Affordable?

Real growth in the Administration's funding request for naval aircraft procurement averages 7 percent a year over the next five years. Even so, there will be shortfalls of aircraft. Eliminating these shortfalls would lead to even higher real growth.

Seven percent annual real growth is significantly more than the real growth in the overall DoD budget. The Administration's budget request for defense calls for average annual real growth of 3 percent over the next five years, but the latest Congressional budget resolution calls for average annual real declines in the DoD budget of as much as 2.4 percent over the next three years. Thus, the Administration's naval aircraft plan appears to be unaffordable unless one or more of the following major policy changes is made: the Congress gives DoD more money than currently anticipated, the Navy receives more than its current share of DoD funding, or the Navy gives aircraft procurement a higher priority than it accords other portions of the budget.

To resolve these issues, the Congress and the Administration must make some difficult choices. More money could be provided for naval aircraft, and this study estimates the additions needed under various assumptions. If more funds are not forthcoming, the Navy may have to reduce its planned numbers of carriers and wings. Alternatively, the Navy could maintain the planned number of carriers but postpone procurement of new types of aircraft in order to hold down costs. Finally, the service could reduce procurement of existing aircraft and keep older ones longer. All these approaches could affect the capability of naval aircraft in both peacetime and war.

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3. Congressional Budget Office, *Effects of Weapons Procurement Stretch-outs on Costs and Schedules* (November 1987).

This study addresses these important decisions. Chapter II provides background on naval aircraft missions and the aircraft that carry them out and discusses the rationale behind the Navy's strategy. Chapter III analyzes the Administration's program for naval aircraft, and Chapter IV describes alternative approaches. The final chapter considers the long-term budget outlook for procurement of naval aircraft.

CHAPTER II

NAVAL MISSIONS, AIRCRAFT, AND STRATEGY

The Navy's plans for aircraft procurement reflect the service's diverse missions in peacetime, during minor conflicts, and in a major war. At the heart of the Navy's current five-year procurement program is the pivotal role it envisions for its aircraft carriers. As background for understanding the program, this chapter discusses the Navy's missions and the aircraft that perform them and then considers both the Navy's rationale for its air strategy and some views opposing that strategy.

MISSIONS

The many combat missions of naval aircraft can be subsumed under five categories: fleet air defense and counterair mission, strike warfare, antisubmarine warfare, electronic warfare, and amphibious assault. Each mission requires different capabilities in the aircraft. Most aircraft are capable of performing more than one type of mission, and many also perform supporting missions that are not discussed here in detail.

Fleet Air Defense and Counterair

The fleet air defense and counterair missions are performed by Navy fighters; Marine Corps fighters would have primarily counterair missions, though they might need to defend the fleet from shore bases or--in emergency situations--from amphibious ships. In the fleet air defense mission, the fighters attack incoming enemy bombers seeking to destroy aircraft carriers and their accompanying ships and amphibious task forces. DoD considers the Soviet Union to be the most likely adversary. And since Soviet bombers are now expected to carry cruise missiles that, according to the Navy, can be launched from distances greater than 250 miles, the speed with which the fighters can get to their attack positions and the range from which they attack are crucial. Also important is "loiter time"--the time the plane can remain aloft--since in high-threat situations the Navy keeps some of its fighters on continuous alert, flying combat air patrol some distance from the carrier.

As with fleet air defense, the targets of the counterair mission are also airborne, but they would more likely be either enemy fighters or strike aircraft that would endanger ground forces rather than attack ships.1/ Since a counterair battle might be fought at closer ranges than are typically expected in fleet air defense, fighter aircraft designed for counterair attacks emphasize both maneuverability and speed.

Strike Warfare

Strike aircraft attack enemy surface targets, such as ground forces and ships, and are the major offensive forces among naval aircraft. Strike aircraft, also called attack aircraft, can be divided into two categories, medium and light, depending on how many pounds of bombs (or "payload") the plane can carry.

Range and payload are important in the design of aircraft for this mission. The longer the range of the attack aircraft, the farther away from a target the carrier can remain or the deeper into enemy territory the plane can bomb, though aerial refueling can extend the ranges of aircraft. (The availability of tankers for aerial refueling may be limited, however, depending on how many carriers are involved in the engagement and how many missions are being pursued at once.) A plane with higher payload is likely to do more damage each time it is sent out. Also important is the ability to hit targets with precision and to survive, either by being less visible to enemy sensors or by maneuvering to evade enemy surface-to-air missiles and enemy fighters. Some strike aircraft for the Marine Corps also emphasize vertical or short takeoff capability in order to provide air power in the absence of airfields, in cases where those

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1. The counterair mission is also performed by strike aircraft--short- and medium-range bombers (discussed later)--when they attack aircraft on the ground and air base facilities.

fields have been damaged, or for operating from amphibious ships in support of forces ashore.

Antisubmarine Warfare

The Navy's antisubmarine warfare (ASW) mission employs several kinds of planes and helicopters as well as surface ships and attack submarines to detect, locate, and destroy enemy submarines. The aircraft have a variety of sensing devices to detect submarines, though the primary devices are acoustic because sound waves are transmitted particularly well by water. ASW aircraft also contain extensive computer resources to transform the data provided by the acoustic devices into usable and timely information. These aircraft must also have extended ranges and long loiter times in order to remain in an area where a submarine has been detected long enough to fix its position and attack it.

Electronic Warfare

The capabilities of the above-mentioned forces are considerably enhanced if they have adequate knowledge about the size, capability, and locations of the enemy; can receive timely commands; and can communicate with each other and with other portions of the battle group. Similarly, the capabilities of enemy forces are degraded if such information can be withheld from them. Electronic warfare (EW) aircraft perform these missions.2/ They detect and track enemy targets and provide airborne battle management. They also provide electronic jamming, which reduces the electronic "vision" of enemy forces, and a barrage of electronic noise to cover attacking strike forces.

Amphibious Assault

The Marine Corps expects to make extensive use of helicopters and fixed-wing aircraft in future amphibious operations. Along with

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2. For the sake of simplicity, the mission of detecting and keeping track of enemy forces has been subsumed under electronic warfare. More typically, the term "electronic warfare" is used by the tactical aircraft community to describe the jamming mission, whereas tracking enemy forces and relaying their locations to friendly forces is called command, control, and communications.

landing craft, aircraft will be used to transport troops and supplies ashore--a strategy called vertical envelopment. Aircraft would be critical in meeting the Marine Corps' goal of moving the assault elements of a Marine amphibious force and a Marine amphibious brigade--or about 11,000 combat troops with their supporting vehicles, artillery, and supplies--ashore within 90 minutes.

The Marine Corps expects to have an amphibious mission in a future war even though the most likely adversary--the Soviet Union--is not an island power as was Japan in World War II. In a future war, amphibious missions could be important for protecting the North Atlantic Treaty Organization's (NATO's) northern flanks around Norway or for protecting its southern flanks in the Mediterranean area.3/ The Marine Corps also argues that it might attempt to divert Soviet attention through assaults on Soviet strongholds in eastern Russia. And if war occurred in Southwest Asia, amphibious missions could take place in the vicinity of the Straits of Hormuz. Amphibious missions could also take place in the South China Sea, south of Thailand, in an effort to keep straits open for transport of Mideast oil to U.S. allies in Asia.

AIRCRAFT

To accomplish these many and diverse missions, the Navy and Marine Corps have about 3,650 active and reserve combat aircraft. The aircraft are organized into 14 active Navy air wings and 3 wings in the active Marine Corps. An additional reserve Marine Corps wing and 2 naval reserve wings would augment or reinforce these forces in war. (Reserve wings train only part-time in peacetime.) A Navy air wing

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3. The Marine Corps intends to preposition the items associated with a Marine amphibious brigade that would be most difficult to move rapidly in a conflict in Norway. As of September 1987, about 43 percent of the items will be in place in central Norway near Trondheim. Marine forces would be expected to augment Norwegian and other NATO forces to prevent the Soviet Union from taking Norway. Should the Soviets take Norway, the Navy and others have argued, convoy traffic to the United Kingdom would be seriously endangered, because sea lines of communication--now only within range of Soviet bomber aircraft--could be attacked by shorter-range Soviet attack aircraft. Norway's mountainous terrain is less amenable to heavy forces, and the Soviet strength there might be less; hence, the lighter forces of the Marine Corps might have an advantage in this area.

usually consists of about 86 aircraft; a Marine Corps wing has about 310 aircraft. The inventory also includes aircraft associated with ASW forces based on land and surface combatants. In addition to aircraft assigned to these forces, other aircraft are used for training and research, and some planes are in repair.

The Navy has at least 16 major types of combat aircraft.4/ The discussion below describes the types most important in this study, organized by mission. Table 1 lists all the types and their primary and secondary missions.

Fleet Air Defense and Counterair Aircraft

Navy and Marine forces contain three kinds of aircraft that perform the fleet air defense or counterair mission--F-14, F/A-18, and F-4. The F/A-18 and the F-4 also perform strike warfare as a primary mission.

F-14 Tomcat. The F-14 is the premier air defense aircraft in the U.S. inventory. A twin-engine, two-seat, supersonic airplane, it can move its wings during flight to optimize its airfoil configuration for different parts of its flight regime. During subsonic flight, and especially during carrier landings when the capacity to stay aloft at comparatively slow speeds is important, the wings are spread to provide the maximum lift. During supersonic flight, the wings are swept back to provide the least drag or resistance to the air. The Tomcat is also the only U.S. plane capable of carrying the long-range Phoenix missile, which can fire at targets from distances of about 80 miles.

The Navy will have bought 583 F-14As through 1988 and plans to procure 55 F-14Ds (a new model) over the five-year period from 1988 to 1992. Consistent with its capability, the F-14D is expensive, with a

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4. Much of the technical detail in this chapter was taken from *Jane's All the World's Aircraft* and *Jane's Weapon Systems* (London, England: Jane's Publishing Company), various editions. Some performance details may represent optimum conditions rather than performance in normal combat situations. Cost data are from the President's budget for fiscal years 1988 and 1989.

TABLE 1. NAVAL AIRCRAFT AND THEIR MISSIONS

Fleet Air Defense	Strike Warfare	Antisubmarine Warfare	Electronic Warfare	Amphibious Assault
		Primary Mission		
F-14	F/A-18	P-3	E-2	CH-46
F-4	A-6	S-3	EA-6	CH-53
F/A-18	AV-8	SH-2	ES-3	V-22
	F-4	SH-3		AH-1
	A-4	SH-60B		
		SH-60F		
		Secondary Mission		
AV-8 a/	F-14	F-14	F-14	---
		A-6	F/A-18	
		F/A-18	P-3	
		V-22 b/	S-3	

SOURCE: Congressional Budget Office from Department of the Navy sources.

a. The Marine Corps indicates that the AV-8 could be used to defend amphibious task forces in emergencies.

b. The Navy is currently considering candidates to replace the S-3 in its ASW mission. The V-22 is considered a candidate.

projected average unit price tag of about $74 million.5/ (Unless otherwise noted, aircraft costs discussed in this section represent total unit procurement costs from 1988 through the remainder of the program, expressed in 1988 dollars).

F/A-18 Hornet. The Hornet is a single-seat, twin-engine, supersonic airplane, capable of performing air defense and counterair plus the strike or attack mission. The plane was selected by the Navy in 1975 as its "low mix" (less capable and cheaper) fighter/attack aircraft. It lacks both the F-14's ability to carry long-range missiles and the long-

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5. A cost of $74 million reflects the cost of new procurement only and was chosen to be consistent with the costs of other planes discussed in this and later sections. The Navy argues that the correct average procurement unit cost for the F-14D program should be about $35 million, reflecting the lower cost of 400 F-14As that will be remanufactured to F-14Ds at the same time the new planes are being built.

range and other capabilities of the A-6 (discussed later). The F/A-18 is, however, substantially cheaper than the F-14, costing $26.4 million each. The Navy has bought 577 F/A-18s and plans to procure 372 more for itself and the Marine Corps over the next five years.

F-4 Phantom. Originally developed in the 1950s, the F-4 has undertaken many of the fighter/attack missions of the Navy and the Marine Corps as well as the Air Force. The Navy and Marine Corps now have about 120 of these aircraft, averaging 18 years of age. The Navy is rapidly phasing out the two-seat, twin-engine, supersonic plane from its inventory, and all should be gone by 1991.

Strike Aircraft

Five types of aircraft perform the Navy's strike or attack mission of bombing surface targets, three of which are still in production. The A-6 and the AV-8 are described here; the F/A-18 was described above.[6]

A-6 Intruder. The Navy's medium-attack aircraft, the A-6, is a two-seat, twin-engine, subsonic airplane that has the electronic equipment to attack surface targets at night and in bad weather.[7] The A-6 also has longer unrefueled ranges and larger payloads than the Navy's other attack aircraft. The A-6 was first introduced into the fleet in 1963 and is still being bought despite concerns about its capabilities. Experience in Lebanon in 1983, when an A-6 attempting to bomb a terrorist stronghold was shot down, contributed to concerns about the survivability of the A-6 against modern defenses. The A-6 lacks the speed and maneuverability to evade enemy defenses if it is detected, and cannot defend itself against enemy aircraft. Nonetheless, the A-6 will be in the inventory for many more years, and so it is being modified to increase its survivability; it will receive a new radar, enhanced avionics, and a new kind of engine.

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[6] The Navy usually divides the bombing missions into two categories-- attacking ships and attacking land targets. The term strike mission is commonly used to describe only the latter.

[7] Carrier battle groups and Marine forces have only light- and medium-attack assets. Heavy-attack assets intended primarily for nuclear attack are now the exclusive province of the Air Force. This change in Naval policy in the 1950s reflected the Navy's concern that improvements in strategic defense might make these missions difficult to accomplish within weight and payload constraints associated with designing planes to take off from and land on carriers, and that more likely wartime scenarios for the future were smaller conventional conflicts.

AV-8B Harrier. The Harrier is a Marine Corps aircraft that has one jet engine and a single seat. It can take off vertically, like a helicopter, or from very short runways or amphibious ships by vectoring engine exhaust toward the ground. The AV-8B Harrier is used by the Marine Corps for air support in close proximity to friendly troops and is replacing the older A-4 aircraft and an earlier, less capable version of the Harrier, the AV-8A. The Harrier is also capable of firing heat-seeking air-to-air missiles.

Antisubmarine Warfare Aircraft

The Navy has two types of fixed-wing aircraft (the P-3 and S-3) and four helicopters (SH-3, SH-2, SH-60B, and SH-60F) that it uses to detect and destroy enemy submarines. The propeller-driven P-3 flies from land bases and uses its long range and extended time on station ("loiter time") to cover wide areas. The S-3 is a carrier-based jet aircraft that provides protection at long ranges from the carrier battle group. The four helicopters are based on carriers and surface combatants and provide protection closer to the carrier battle group.

Electronic Warfare Aircraft

This family of aircraft provides command, control, and communications to the carrier battle group and actively supports the battle group's activities by providing electronic jamming. The carrier-based E-2 is an airborne listening post that would loiter above the battle group, provide information to the forces about target location, and guide forces to attack enemy forces. The E-2C is a two-engine, turboprop plane with a crew of five. It can detect airborne targets anywhere within an area of 3 million cubic miles and can track more than 600 targets and control 40 airborne intercepts.8/ E-2s can also track ships

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8. *Jane's All The World's Aircraft*. These figures may represent optimum conditions.

and can detect small airborne targets like cruise missiles. Reflecting its extensive capabilities, the E-2C is one of the more costly naval aircraft, at about $65 million each. The EA-6 is a variant of the A-6 and performs tactical jamming to baffle enemy radars. The ES-3 is a modified S-3 that the Navy plans for an electronic battle group support mission.

Amphibious Assault Aircraft

The amphibious assault mission--moving troops and equipment to assault a beachhead--is performed by two Marine Corps helicopters, the CH-46 and the CH-53. The CH-46 is a medium-lift helicopter that can carry 17 troops or 4,200 pounds of equipment. The primary mission of the CH-53E is transporting heavy cargo from ship to shore--the heavy-assault mission. Though one version, the CH-53E, can carry up to 55 troops or 32,000 pounds of cargo, the Marine Corps states that it would be limited to no more than 30 troops, because of its vulnerability to ground fire and also to lessen the impact of the loss of one helicopter. Both the CH-46 and CH-53 are unarmed.

A third helicopter, the AH-1, provides combat fire support to the amphibious assault. This helicopter, which is also found in Army inventories, carries guns and missiles for attacking enemy troop positions and armored vehicles.

New Aircraft

The Navy intends to begin two new aircraft procurement programs during the coming five-year period--the Long-Range Air ASW Capable Aircraft (LRAACA) and the V-22 medium-assault aircraft. Procurement of both programs is scheduled to begin in 1990, and their inclusion in the aircraft procurement account contributes so substantially to costs that funding is scheduled to grow by almost 20 percent in real terms over 1989.

The LRAACA is supposed to be either a more austere and less expensive variant of the P-3 or a more expensive variant of a commercial aircraft that, having longer endurance, could be bought in smaller quantities. The LRAACA must be a variant of some existing plane, since the three-year development period does not allow enough time to produce a new aircraft.[9] Navy estimates of funds for the plane would indicate an average cost of about $46 million, or roughly $6 million less than the average P-3C cost (over the life of the P-3C program from 1983 to 1987).

The V-22 (still widely known as the JVX) is a new tilt-rotor aircraft that will eventually replace the CH-46 in performing the Marine Corps' medium-assault mission. The V-22 will take off and land like a helicopter, or it can make short rolling takeoffs to increase range and payload. In flight it will flip ("tilt") its rotor assemblies into a horizontal position and will function like a fixed-wing aircraft. While the Army and Air Force have also indicated requirements for these planes, the Marine Corps has the earliest and largest requirement. The Navy may also be considering a variant of the V-22 for antisubmarine warfare. Current program estimates for the V-22 indicate a unit cost of about $25 million, or about four times the original procurement cost (in 1988 dollars) of the CH-46 it is to replace, though the Marine Corps argues that it will also provide substantial improvements in speed, range, and survivability.

The Navy also plans a new plane to replace its A-6 attack aircraft, though apparently not until the mid-1990s. This plane, currently designated the Advanced Tactical Aircraft (ATA), is expected to be stealthy--that is, less visible to enemy sensors. Official details about the cost and other features are not available. Chapter V discusses what is publicly known about the aircraft.

STRATEGY

Naval aircraft, the Administration argues, would play a key wartime role in attacking enemy forces and bottling up Soviet naval forces that

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9. The Navy released the request for proposal (RFP) for the LRAACA this fall. Informal sources indicate that Boeing, Lockheed-California, McDonnell Douglas, and Gulfstream Aerospace expressed interest in participating. Apparently the Navy specified its requirements in terms of the capabilities required for the fleet of aircraft rather than specifying a minimum number of planes bought, thus enabling companies to propose more capable aircraft that are more expensive but may be able to perform the mission in smaller quantities.

could otherwise attack friendly ships. Some analysts, however, disagree about the usefulness of naval aircraft and question the reasonableness of the Navy's plans for deployment of aircraft carriers. Although different issues are raised about Navy and Marine Corps aircraft, the issues surrounding both are contentious.

Navy Aircraft

Most of the issues surrounding Navy aircraft relate to the utility of aircraft carriers, both in peacetime and in a major war.

Peacetime and Minor Conflicts. In peacetime, the U.S. Navy keeps about four or five aircraft carriers deployed overseas at all times. Deployments vary with world events, but a typical recent deployment saw two carriers in the Mediterranean Sea, one or two near Japan, and one outside the Persian Gulf. The carriers are there to make foreign countries aware of U.S. military capability--that is, to "show the flag." They may also participate in minor hostilities. For example, some of the aircraft that attacked Libya in 1985 flew off carriers; carriers also supported the invasion of Grenada in 1983. In addition, the Navy has continuously deployed two or three amphibious ready groups (that is, forward-deployed amphibious task forces) to the Mediterranean and the Western Pacific. One such group participated in the 1983 Grenada invasion. Marine helicopters and AV-8s normally operate from these amphibious ready groups.

In conflicts that are more than minor but do not directly involve the Soviet Union, aircraft carriers may not face significant threats. In such cases they can operate as floating air bases, launching strikes against land targets. During the Vietnam War, for example, the United States typically brought its carriers to within 100 miles of the Vietnamese coast because North Vietnamese forces posed no significant threat to them. Carrier aircraft were thus able to operate at significantly shorter ranges than were land-based aircraft, which typically operated from bases in Thailand. The advantages of aircraft carriers were also exemplified by the extensive early employment of carrier-based aircraft while airfields were being built.

Few analysts question the utility of having some aircraft carriers deployed in peacetime and minor hostilities. When they face little opposition, aircraft carriers allow the United States to display airborne military capability without depending on landing rights in foreign countries. Indeed, naval forces--including airborne forces--have been by far the most frequent choice of U.S. policymakers during periods of tension. The Navy has said that its forces have taken part in more than 80 percent of the crises confronting the United States since 1946.

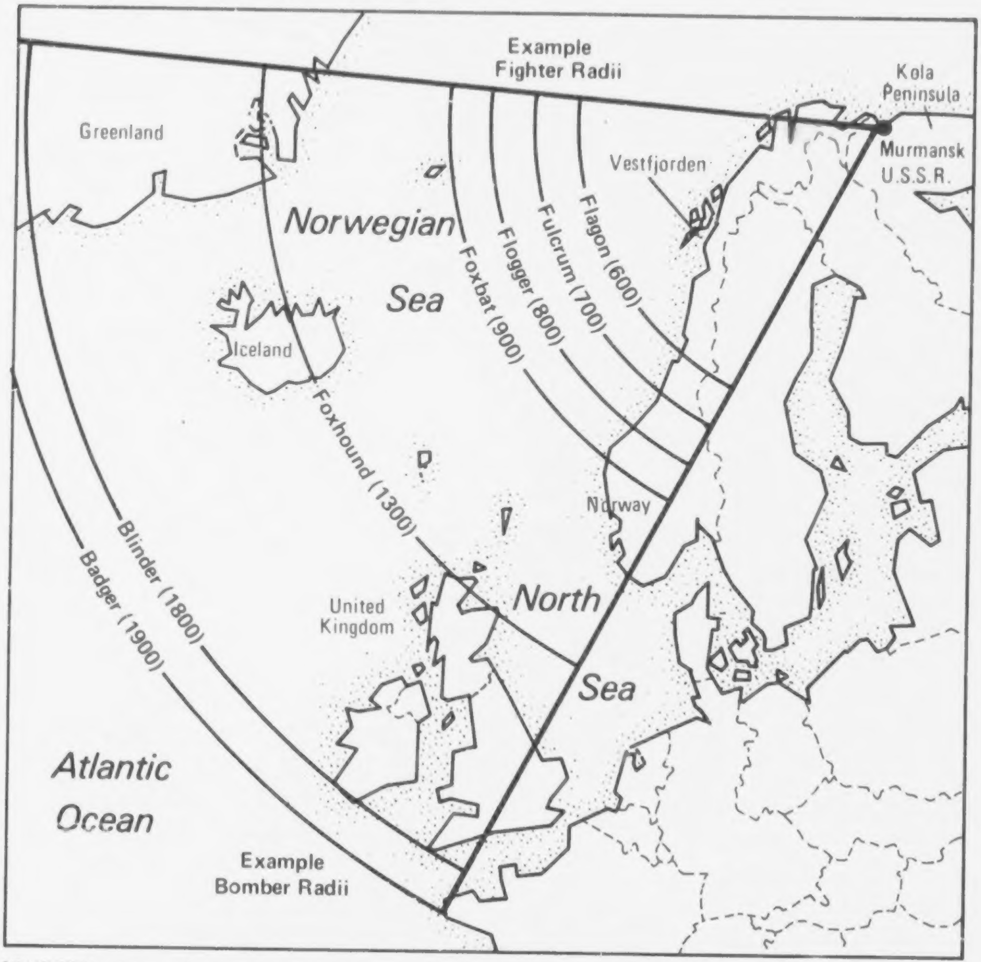
While the need for some carriers is widely accepted, the need for the United States to keep four or five carriers constantly deployed overseas during peacetime is not. This issue has important budget implications, since peacetime deployments influence the number of carriers that are needed and hence the needs for aircraft (though they do not determine the quality of the required aircraft). The Navy feels that three carriers are needed to keep one deployed continually. Critics argue that the United States could follow a policy of "surge" deployments--that is, limiting peacetime deployments, but then augmenting the number of carriers in a key region when events warranted such action. The Navy counters by noting the difficulties of getting forces to distant areas--particularly areas like the Persian Gulf--quickly enough in the face of rapidly changing world events. To date, several presidents have chosen to keep four or five aircraft carriers deployed overseas in peacetime, indicating that that number may be decided at higher policy levels than the Navy.

Some critics have questioned the Navy's 3-to-1 ratio, arguing that peacetime deployments have been at current rates even in times when the Navy's carrier force was smaller. The Navy counters that this situation places undue stress on Navy personnel and may contribute to problems in retaining manpower.

Major War. Concerns about carriers' capabilities in a major war are more pronounced. In a war against the Soviet Union, carrier battle groups--together with U.S. attack submarines--would be the vanguard of the so-called forward offensive strategy. Under this strategy, naval forces would attempt to gain control in the northern Norwegian Sea and might attempt to strike Soviet forces based on or near the Kola peninsula north of Norway (see Figure 1 for a description of this area). Carriers might also assist Marine forces in the mission of defending northern Norway from Soviet attack. The Navy intends such a

Figure 1.

Examples of Radii of Unrefueled Soviet Bombers and Fighters from the Kola Peninsula


Example
Fighter Radii
Kola
Peninsula
Murmansk
U.S.S.R.
Greenland
Vestfjorden
Norwegian
Sea
Flagon (600)
Fulcrum (700)
Flogger (800)
Foxbat (900)
Iceland
Foxhound (1300)
Norway
United
Kingdom
North
Sea
Blinder (1800)
Badger (1900)
Atlantic
Ocean
Example
Bomber Radii

SOURCES: Congressional Budget Office estimates from radius data presented in Department of Defense, *Soviet Military Power* (1985); deployment data in International Institute for Strategic Studies, *The Military Balance 1985-1986* (Letchworth, England: Garden City Press, Ltd., 1985); and information from Soviet Studies Research Centre, RMA Sandhurst, *Soviet Amphibious Warfare and War on the Northern Flank* (The Hague, The Netherlands: SHAPE Technical Centre, December 1984).

NOTE: Radii – the distance a plane can reach and still have fuel to return to base – are listed in statute miles. Radii are intended to be approximations and are subject to substantial variations depending on a variety of assumptions including flight profile, refueling, and flight path. The exact nature of Soviet deployments or plans to redeploy to this area are unknown; planes in the example were chosen because they are listed in *The Military Balance* as having responsibility for the Kola area.

strategy to force the Soviet Union either to withhold forces that might otherwise be used to attack sea lines of communication (where convoys resupplying friendly forces would transit) or to assist in the central European battle in order to attack Norway, defend the Soviet homeland, and protect Soviet ballistic missile submarines (SSBNs) that carry strategic nuclear missiles.10/ Soviet naval doctrine states that protecting the SSBNs is the Soviet Navy's most important task.

U.S. naval forces would also pursue a forward strategy in the area of the Kamchatka peninsula in the northern Pacific and in Vladivostok in the Sea of Japan, the other location for Soviet SSBNs. The desire for simultaneous forward deployments in these areas, together with several other flanking attacks, drives the Navy to its goal of 15 carriers.11/ Navy plans for these carrier deployments are shown in the table below.

	Navy Estimates of Carrier Requirements (By fleet)	
	Peacetime	Wartime
Sixth Fleet (Mediterranean)	1.3	4
Second Fleet (Atlantic)	6.7	4
Seventh Fleet (W. Pacific)	2	5
Third Fleet (E. Pacific)	5	2
Total	15	15

Figures for the Second and Third Fleets include forces in overhaul; figures for the Seventh Fleet include forces in the Indian Ocean.

Critics assert that carriers fighting near the Soviet homeland, within range of Soviet land-based aircraft, may be too vulnerable.

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10. Admiral James D. Watkins, USN, "The Maritime Strategy" (U.S. Naval Institute, Annapolis, Md., January 1986), pp. 2-17.

11. John F. Lehman, Jr., "The 600-Ship Navy" (U.S. Naval Institute, Annapolis, Md., January 1986).

Using the Norwegian Sea forward strategy as an example, a recent study by the Brookings Institution posits losing as many as eight or nine carriers, depending on the number committed to the strategy.12/ Indeed, as Figure 1 shows, moving a carrier within striking range of Murmansk would also bring it within range of an extensive array of Soviet forces. A carrier battle group sailing as far north as Vestfjorden in northern Norway, for example, could come under attack by land-based Soviet naval aviation bombers--from 85 to about 250 planes in the Northern and Baltic fleets.13/ At this range, Soviet bomber forces could be accompanied by about 270 Soviet fighters and interceptors in this area.14/ And a greater number of Soviet attack submarines and surface combatants might be encountered this far north. The recent mining of the Persian Gulf by Iran may suggest an additional problem--that of finding and destroying mines--if the Soviet Union chose to mine these northern waters.

The Navy counters that it will be able to defend the carriers, using the strategy of defense in depth. The attacking Soviet aircraft will be met at long ranges by counterair aircraft based on the carriers. The attacking aircraft that avoid these counterair aircraft, and any enemy missiles that are launched, will be attacked by ships defending the carriers, including the new Aegis cruiser with its highly sophisticated defensive systems. Similar defense in depth is planned for attacks from enemy submarines.15/

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12. William Kaufman, *A Thoroughly Efficient Navy* (Washington, D.C.: Brookings Institution, 1987), p. 130.

13. The higher numbers in this wide range of estimates come from Congressional Research Service, *U.S.-Soviet Military Balance 1980-1985* (1985). The lower numbers come from International Institute for Strategic Studies, *The Military Balance 1985-1986* (Letchworth, England: Garden City Press Ltd., 1985). The range may result, at least in part, from differing views of the likely roles of planes such as the Tu-16 Badger that can have reconnaissance, bomber, and tanking roles.

14. International Institute for Strategic Studies, *The Military Balance 1985-1986*. The Soviet Union deploys 270 fighters to its northwestern air defense district. The district, with headquarters in Archangel, has responsibility for the Kola peninsula. These aircraft could be augmented with planes stationed at Leningrad (145 fighter/attack aircraft) or at Kaliningrad (250 fighters).

15. Soviet Northern Fleet submarine forces total 116, according to the International Institute for Strategic Studies. The Navy's estimate for the area is apparently about 180. Many critics feel that defending against submarines is an even more difficult task for carriers than air defense.

The Navy also argues that positioning the carriers farther away from the Soviet Union would not solve the problem of vulnerability. Even carriers positioned somewhat south of the Greenland-Iceland-United Kingdom gap would still be within bomber range of Soviet land-based aircraft and would be too far away to pose a credible threat to Soviet forces.16/ (Although Soviet bombers could indeed attack the carriers at these ranges, they would have to fly unaccompanied by fighters, thus becoming more vulnerable to carrier-based fighters.) Moreover, the Navy argues, a passive defense at the gap gives up substantial flexibility and is, in effect, abandoning Norway to the Soviet forces.

According to some Navy discussions of the maritime strategy, this problem of vulnerability would be solved if carrier attacks occurred after Soviet land-based and submarine-based threats had been destroyed by allied forces (though exactly how this might be done is unclear). At least for the submarine threat, this strategy may be feasible since the Navy, while not always specific about the timing of attacks associated with the forward offensive strategy, appears to assume that carriers would move north behind U.S. attack submarines. The exact allied forces that would destroy Soviet fighters and bombers are even less clearly specified, though the Navy frequently refers to "wearing down" the Soviet forces. This approach may mean a more gradual war of attrition, where attacks on the Soviet mainland would occur only after the carriers fought their way slowly north. While this view of a more paced maritime strategy may answer critics' concerns about the carriers' vulnerability, it is less clear how it jibes with the Navy's stated intent for that strategy: surprising the Soviet Union and diverting its energies from the central front.

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16. This area is commonly viewed as a good place to set up a barrier defense against submarines because the characteristics of water depth and location of thermal layers make it a more difficult area for submarines to transit without being detected. Even if staying south of the gap does not prevent the carriers from being in bomber range, it might aid in the antisubmarine warfare mission. Thus, it could be argued that the Navy gives up a natural ASW defense by steaming north of the gap. See Tom Stefanick, *Strategic Antisubmarine Warfare and Naval Strategy* (Lexington, Mass.: Lexington Books, 1987), for an extensive description of the waters in this area (as well as an overall discussion of the ASW mission).

Some analysts have expressed concern that the Soviet Union would view U.S. attacks against its SSBNs as sufficient cause for nuclear escalation, even if the attacks involved conventional munitions.17/ The Navy avers that the Soviet Union also plans a war of attrition against U.S. SSBNs in the early stages of a conventional war and thus may not begin to use nuclear weapons.

Critics of aircraft carriers assert that, in addition to being vulnerable, the carriers are too expensive relative to their offensive capability. A modern large-deck carrier and its associated air wing cost about $9 billion to buy and another $0.5 billion a year to operate (in constant 1988 dollars). Such a carrier embarks 80 to 90 aircraft, but about 50 are designed to protect the carrier itself and its strike aircraft. Moreover, the payload of many of the roughly 40 strike aircraft may be relatively small or their ranges relatively short if they are not refueled. Ranges might be even more limited if strike aircraft have to be accompanied by carrier-based fighters for protection, since both fighters and strike aircraft might require refueling and tanker assets may be limited.18/

The Navy counters that the United States must pay the price for aircraft carriers because the country cannot depend on having access to air bases in foreign countries. Access could be denied by a neutral country or by a country that has been overrun by enemy forces. The United States might have to take these bases by force. In addition, land bases themselves would be vulnerable, in some cases more vulnerable than carriers because the carrier can move. As for the high cost, it is necessary, the Navy argues, because aircraft carriers may

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17. See Joshua M. Epstein, *The 1988 Defense Budget* (Washington, D.C.: Brookings Institution, 1987), p. 52, for a discussion of potential nuclear escalation associated with forward offensive strategy. That study also suggests that--should the Soviets move to nuclear weapons--the forward-deployed carriers would make tempting targets for nuclear attack.

18. Concerns about the offensive capabilities of naval aviation also have bearing on the forward offensive strategy. Some critics question whether naval aircraft, even brought within range of the northern Soviet bases, could do much damage. These concerns may be appropriate since many analysts feel that air bases are difficult to keep closed for prolonged periods, and catching planes in the open may require considerable intelligence information. The Navy would argue that carriers may provide the bulk of strike aircraft that could be brought within range at all.

face intense enemy threats and must therefore have extensive defenses.

This study cannot resolve these many issues, though their resolution does govern one's judgment about the desirability of the Administration's plan for naval aircraft and alternatives to it. Instead, the study focuses on alternatives consistent with differing views of the utility of carriers. The Congress has been quite supportive of aircraft carriers. This year, for example, key committees have authorized the initial funds for purchase of two new nuclear aircraft carriers.

Marine Corps Aircraft

Questions have also been raised about aviation forces for the Marine Corps. Specific concerns revolve around the funding required to pursue the Corps' goal of improving its capacity to move troops and equipment rapidly from transport ship to shore. The Marine Corps' strategy of vertical envelopment places emphasis on transporting many of the forces by air.

A key part of this improvement is the development of a new tilt-rotor aircraft designated the V-22. The V-22 can take off or land like a helicopter either from ships or shore bases. Then, in flight, it can flip its rotors forward and achieve the greater speeds characteristic of fixed-wing aircraft. The Marine Corps feels that replacing existing helicopters with the V-22 will give its force flexibility and the ability to survive in the modern battlefield.

Critics question the desirability of such advanced technology, which could entail increased maintenance requirements, in the usually austere Marine Corps. Increasing maintenance requirements in the battlefield conditions of an amphibious assault could hurt performance. Moreover, the high cost of the V-22 has led some people, including the new Secretary of the Navy, to ask whether the program is cost effective. The Secretary, who had also expressed concerns about the potential vulnerability of the V-22 in battlefield conditions, is now supportive of the program, according to press reports. Many critics also question whether the V-22 will actually be bought at the prices assumed by the Marine Corps, especially since the unit cost assumes procurement by the Army and Air Force. Both of these services may have more pressing requirements when the time comes for V-22 procurement.19/

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19. House Committee on Armed Services, *The V-22 Osprey (Formerly JVX): Is the Case for Tilt Rotor Tilted?*, Staff Study 99-3 (March 1986). This report also questions whether the capabilities planned for the V-22--in particular, speed and range--are needed. Because increasing capabilities drive up costs, the study asked whether a plane with these greater capabilities would mesh well with the rest of the equipment being bought for the landing team. Broadly, the study finds that assault waves will have to be brought in more slowly and from closer ranges than hypothesized in V-22 requirements, because of the capability of other pieces of equipment. The Marine Corps argues that these capabilities will provide additional flexibility that will be needed.

CHAPTER III

ADMINISTRATION'S PLANS FOR NAVAL COMBAT AIRCRAFT

Because of the needs associated with the forward offensive strategy planned by the Administration, the Navy must meet the requirements of an expanded force structure and improve its aircraft capabilities through modernization. Accordingly, the Administration plans to buy 1,085 naval combat aircraft over the next five years.

Under those plans, spending in the Navy's aircraft account would grow at an average rate of 7 percent a year in real terms between 1987 and 1992. Even with this growth, however, the Navy's aircraft inventories would be short of requirements by 176 aircraft in the 1990s. The resulting shortfall (that is, requirements minus inventory) could be substantially larger under alternate but plausible assumptions about how long aircraft can remain in service. Any attempt to offset these shortfalls by buying more aircraft would substantially increase the growth in costs.

AIRCRAFT INVENTORIES

Inventories of naval aircraft to meet the needs of combat forces total 3,644 aircraft in 1987 and will increase to about 3,920 by 1994, the first year when all aircraft purchased over the next five years will have entered the fleet (see Figure 2). These results assume the Navy's five-year plan for aircraft procurement (see Table 2) and a variety of

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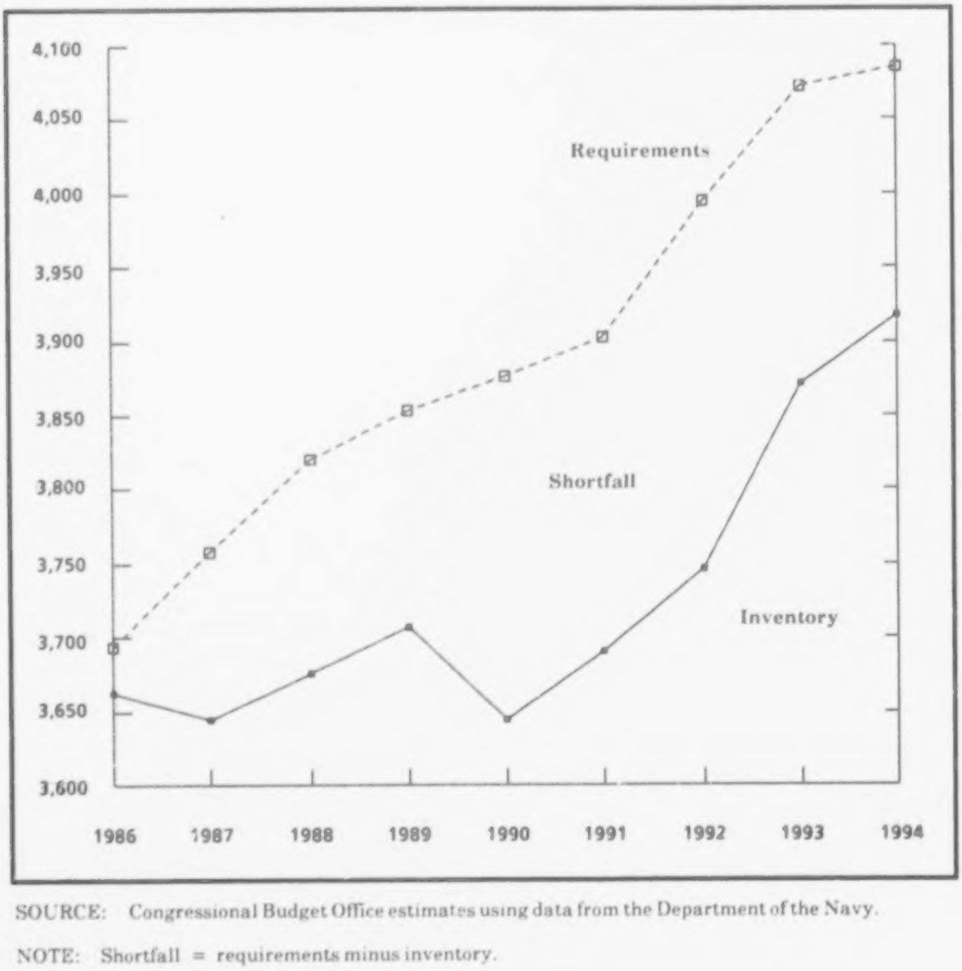
NOTE: The detailed assumptions used in this analysis to estimate requirements and inventories were provided to CBO in early 1987 by the Navy as being consistent with the President's budget for fiscal years 1988 and 1989. The Navy has published a new Naval Aviation Plan this fall. Apparently the expected aircraft procurement has not changed in this plan, but it appears that the Navy may have changed these requirements (details of the changes are classified). Hence, the results of this analysis could be different if CBO were able to reflect the assumptions associated with the new plan.

assumptions supplied by the Navy--for example, how long planes are expected to remain in service and how many will crash each year during peacetime training. Aircraft considered in this study include all those purchased in the combat budget activity of the Navy's aircraft procurement account.

FIGURE 2. NUMBER OF NAVAL COMBAT AIRCRAFT: REQUIREMENTS, INVENTORY, AND SHORTFALL



SOURCE: Congressional Budget Office estimates using data from the Department of the Navy.

NOTE: Shortfall = requirements minus inventory.

This growing inventory of naval aircraft will increase slightly in average age. The inventory averages 12.2 years of age in 1987; under the Administration's plans, that average would increase to 12.9 years by 1994 (see Figure 3). However, the fleet of fighter and attack aircraft, whose stressful missions may make age a more important factor, will be younger than it is today--10.6 years in 1987 compared with 10.3 years in 1994.

TABLE 2. PLANNED PROCUREMENT OF NAVAL COMBAT AIRCRAFT (Number of aircraft, by fiscal year)

Aircraft	1987 Approved	1988	1989	1990	1991	1992
A-6E/F	11	12	18	24	24	36
EA-6E	12	6	9	9	9	9
AV-8B	42	32	32	15	15	15
F-14A/D	15	12	12	19	30	42
F/A-18	84	84	72	72	72	72
CH-53E	14	14	14	4	0	0
V-22	0	0	0	12	45	61
AH-1W	0	22	12	0	0	0
SH-60B	17	6	6	6	12	12
SH-60F	7	18	18	18	12	12
P-3C/G	9	0	0	4	25	25
E-2C	10	6	6	6	6	6
SH-2F	6	0	0	0	0	0
EXCOMP a/	0	8	8	0	0	0
Total, Excluding Modifications b/	227	212	199	182	232	260
Total, Including Modifications	227	220	207	189	250	290

SOURCE: Congressional Budget Office presentation of data submitted in the President's budget for fiscal years 1988 and 1989.

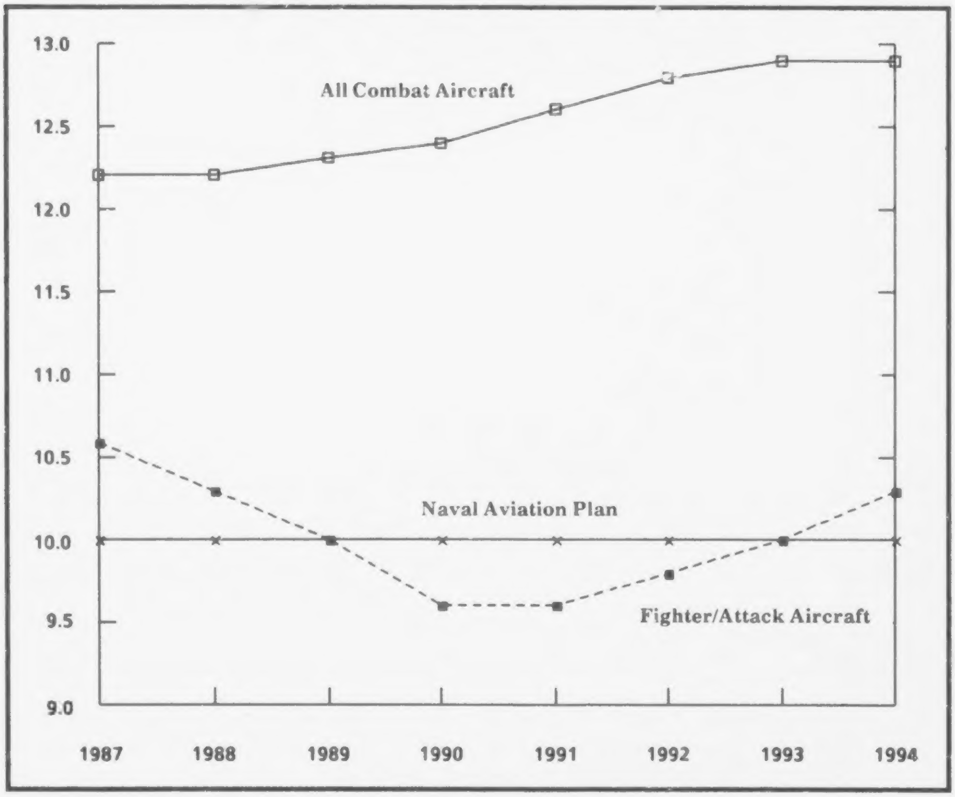
a. EXCOMP is a program to solicit bids for a new electronic support aircraft. After the budget was submitted, the Navy apparently decided to modify several S-3 aircraft for electronic support.

b. Annual procurement of new F-14s totals only 12 in each of the five years of the defense plan. The rest of the planes listed in the F-14 line and all of the planes listed under EXCOMP are modifications to existing aircraft and are counted in the "Total, Including Modifications" line below.

While encouraging, these five-year results for fighter and attack aircraft mask less reassuring trends. Between 1987 and 1990, the average age of fighter and attack aircraft decreases because of large procurements that occurred between 1983 and 1987 and because of retirements of older aircraft (see Figure 4 for historical procurement of fighter and attack aircraft). By the 1990s, deliveries of fighter and attack aircraft will be reduced and retirements will be substantially complete; hence, average age will begin to rise.

Although the Navy has not established a goal for average age for combat aircraft, the last three Naval Aviation Plans--a document published annually by the Navy to describe its aviation require-

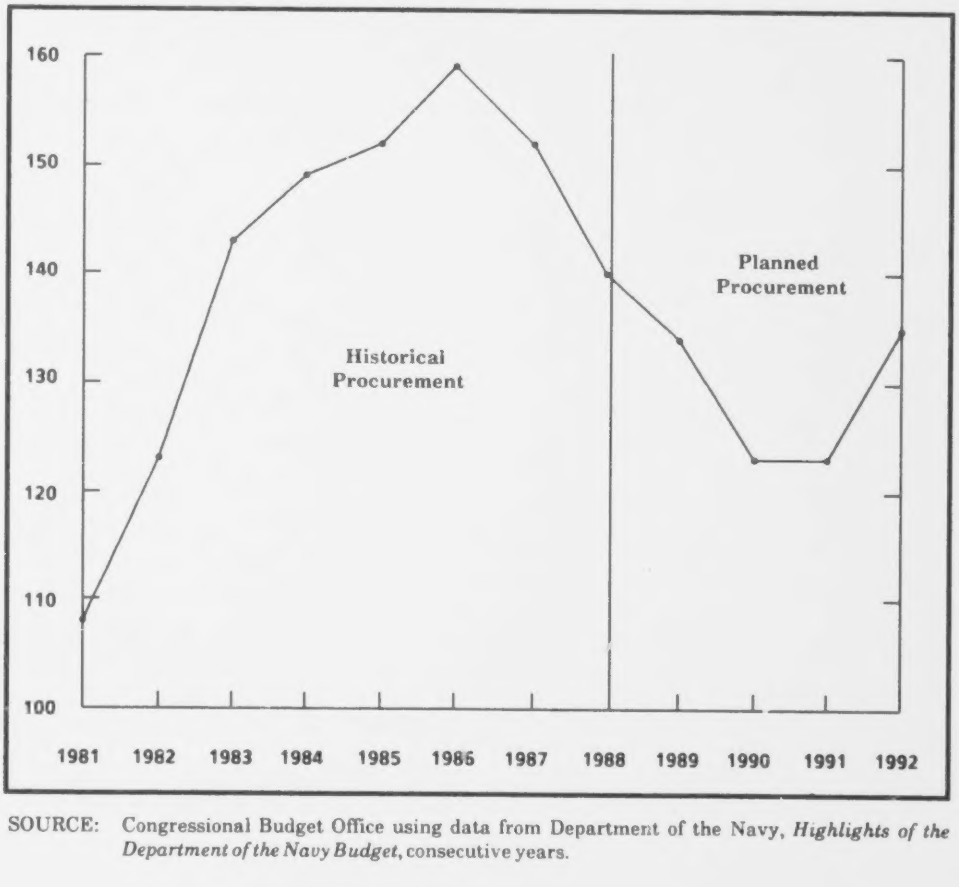
FIGURE 3. AVERAGE AGE OF NAVAL COMBAT AIRCRAFT (In years)



SOURCE: Congressional Budget Office estimates using data from the Department of the Navy.

ments--have typically assumed a 20-year service life for combat aircraft when computing annual procurement. If planes with a 20-year service life are evenly distributed in age, the average age of the fleet would be 10 years. By this measure, today's fleet is about 22 percent older than the Navy's goal. This goal of a 10-year average age appears to have been relaxed somewhat; estimates would range from 11.5 to 13.0 years based on the Navy's current assumptions about retirement. On the other hand, the Navy once argued that because of the extraordinary stress its planes undergo, and because of corrosion

FIGURE 4. NUMBER OF FIGHTER/ATTACK AIRCRAFT PROCURED, FISCAL YEARS 1981-1992



SOURCE: Congressional Budget Office using data from Department of the Navy, *Highlights of the Department of the Navy Budget*, consecutive years.

from salt water, at least its fighter/attack aircraft should retire at 15 years of age--an average age of 7.5 years.[1]

What is the importance of average age? In the past, the Navy has argued that the aging of its aircraft fleet is important because older planes are more costly to operate and maintain. Older planes also suffer from greater downtime for repair and modification, which adversely affects training. (There is, however, little data on repair times and operating costs of Navy aircraft. Thus the impact of continued aging cannot be quantified.) The Navy also argues that the age of its aircraft is an important if rough measure of its ability to meet an increasingly capable enemy threat. By this measure, the Navy inventory is becoming slightly less capable.

REQUIREMENTS FOR NAVAL AIRCRAFT

Naval combat aircraft must fulfill a variety of needs. Most aircraft are deployed in operating forces, including:

- Navy carrier-based air wings, 14 active and 2 reserve (a wing contains about 86 aircraft);
- Navy land-based antisubmarine warfare (ASW) squadrons, 26 active and 13 reserve (a squadron typically contains 9 aircraft);
- Navy ASW forces aboard surface combatants, eventually totaling about 250 aircraft; and
- Marine Corps air wings, 3 active and 1 reserve (with an average of about 310 planes each).

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1. The simple metric of dividing desired retirement age by two has been used by both the Navy and the Air Force to describe how many planes need to be bought annually to maintain a particular force structure. This method assumes, of course, that planes are evenly distributed in age, an assumption that is never met.

In addition to aircraft needed in operating units, aircraft are needed for various support activities, including:

- The Navy's pilot-training squadrons;
- Replacements for aircraft in repair; and
- Testing of new tactics and equipment.

Requirements depend not only on the number of units but also on their configuration--that is, the number of each type of aircraft in the wing. The Navy bases requirements on four types of wing configurations that are used for planning--the Midway, the Kennedy, the standard, and the notional (see Table 3). Wings might never actually be deployed with these exact configurations, since the types of planes placed in a deploying unit will depend on the specific mission. Nonetheless, these theoretical configurations, supplied by the Navy, are needed for planning. The "notional" configuration was the result of a long-term Navy study to determine the optimal configuration for its air wings. It will eventually replace all of the "standard" air wings. As the table shows, the notional wing has the same total number of aircraft as its predecessor, but it has more A-6 aircraft, fewer F-14s and F/A-18s, as well as a small increase in electronic warfare aircraft.

These various assumptions lead to gradually increasing requirements (see Figure 2). Requirements rise from 3,820 aircraft in 1988 to 4,085 aircraft in 1994. The increase stems largely from fleshing out the Navy's carrier air wings, from increases in the Marine Corps' amphibious lift forces, and from modest increases in antisubmarine and electronic warfare forces.[2]

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[2] Some of the difference between the Navy's 1994 requirement of 4,085 aircraft and today's requirement of 3,820 might be described as current unmet requirements. For example, even though the Navy's force structure would indicate that there are two reserve wings, many reserve squadrons do not have complements equal to active wings. By 1994, the Navy will have increased the size of these squadrons to more closely resemble active squadrons. Authorizations for Marine Corps amphibious lift squadrons present a similar situation. Squadron authorizations were higher in the 1970s than they are now. According to the Marine Corps, this result occurs more because the service lacks planes to fill the squadrons than because the threat has decreased. Hence, the increase for the amphibious assault mission--about 100 planes--during the period from 1987 to 1994 is really more a return to past force levels.

TABLE 3. COMPOSITION OF NAVAL AIR WINGS

Aircraft	Air Wing Configurations (Number of aircraft) Midway a/	Kennedy b/	Standard	Notional
F-4 and F-14	0	24	24	20
A-7 and F/A-18	36	0	24	20
A-6 and KA-6	16	28	14	20
S-3	0	10	10	10
SH-3 and SH-60F	6	8	6	6
EA-6	4	5	4	5
E-2	4	5	4	5
Total	66	80	86	86

SOURCE: Congressional Budget Office using wing configurations supplied by the Department of the Navy.

a. Two carriers, the Midway and the Coral Sea, have this kind of air wing.

b. Two carriers, the Kennedy and the Ranger, have this kind of air wing.

The current level of requirements, and the gradual increase, reflect the Navy's estimates of aircraft needed to meet peacetime needs and to prevail in the event of war. As the Soviet Union develops increasingly capable systems and increases the size of its forces, the Navy intends its forces to do the same. The Navy is particularly concerned about the dramatic quieting of Soviet submarines, Soviet advances in the area of land-based aviation, and Soviet plans to field a conventional aircraft carrier in the early 1990s.[3] The forward offensive strategy becomes much more difficult as, for example, the stand-off ranges--the distances from which Soviet bombers can fire missiles--increase. Carrying out that strategy will become even more difficult if the Soviet Union develops conventional aircraft carriers that can bring its aircraft closer to U.S. carriers. The amount of time for accomplishing Marine amphibious assaults shortens as Soviet command, control, and communications capabilities improve. And larger, more capable antisubmarine forces are needed to detect quieter Soviet submarines.

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[3] Problems with expense and complexity could delay the Soviet Union's fielding of a conventional aircraft carrier. Indeed, recent press reports seem to indicate that the Soviet Union may have delayed or even abandoned those plans (Robert C. Toth, "Soviets Seen Cutting Navy's Global Reach," *Los Angeles Times,* October 22, 1987). Moreover, the arguments about the vulnerability and expense of U.S. carriers discussed in Chapter II would also apply to Soviet carriers. If one believes that the Soviet Union would be facing these problems, then U.S. concerns about capability might be reduced even if Soviet plans proceed as DoD projects.

AIRCRAFT SHORTFALLS

Comparing the 1994 total for requirements with the 1994 total for inventories yields a shortfall of 226 planes of eight aircraft types and an overage of 50 planes of six aircraft types. Thus, the net shortfall for Navy planes in 1994 will total 176.[4] Table 4 shows these shortfalls and overages by aircraft type.

The main reason for shortfalls of combat aircraft is the Navy's decision to buy fewer planes. Each year the Navy supplies the Congress with a five-year plan for aircraft procurement. The latest five-year plan (1988-1992) buys 440 fewer aircraft in the 1988-1991 period than did last year's plan (the years 1988 to 1991 represent the common four years of the two plans). The latest Navy plan generally has not cut back on the total number of aircraft types that the Navy eventually plans to buy. Rather, this year's plan "stretches out" production by cutting back on the rate of annual procurement. In addition, both plans have substantial "out-year loading"; that is, the numbers of planes procured toward the end of the plan and further away from the budget year are larger.

This shortfall will probably continue unless changes are made in current policies. The Navy estimates that, over the long run, it needs to buy about 330 aircraft a year to meet all its planned requirements for Navy and Marine Corps aircraft while avoiding further increases in average age of the fleet. Figure 5 shows that the latest five-year

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4. Net shortfalls are used throughout the paper because they represent to some extent the fungibility of aircraft procurement dollars--that is, the Navy could take funds from planes that are in oversupply and apply them to planes where there are shortfalls. These net shortfalls may, however, underestimate the problem, since a number of the planes listed here perform more than one mission.

procurement plan falls well short of this goal, averaging 247 aircraft a year. In contrast, last year's plan averaged 357 aircraft each year, reflecting the Navy's view at that time that extra planes were needed to fill out an increasing force and to lower the average age of the force.

Implications of a Shortfall

The size of a shortfall is not itself a complete indicator of defense capability. The United States could reduce shortfalls by eliminating aircraft carriers, but that would decrease overall defense capability rather than increase it. Shortfalls are, however, a reasonable measure

TABLE 4. SHORTFALLS (OVERAGES) OF NAVAL COMBAT AIRCRAFT IN 1994

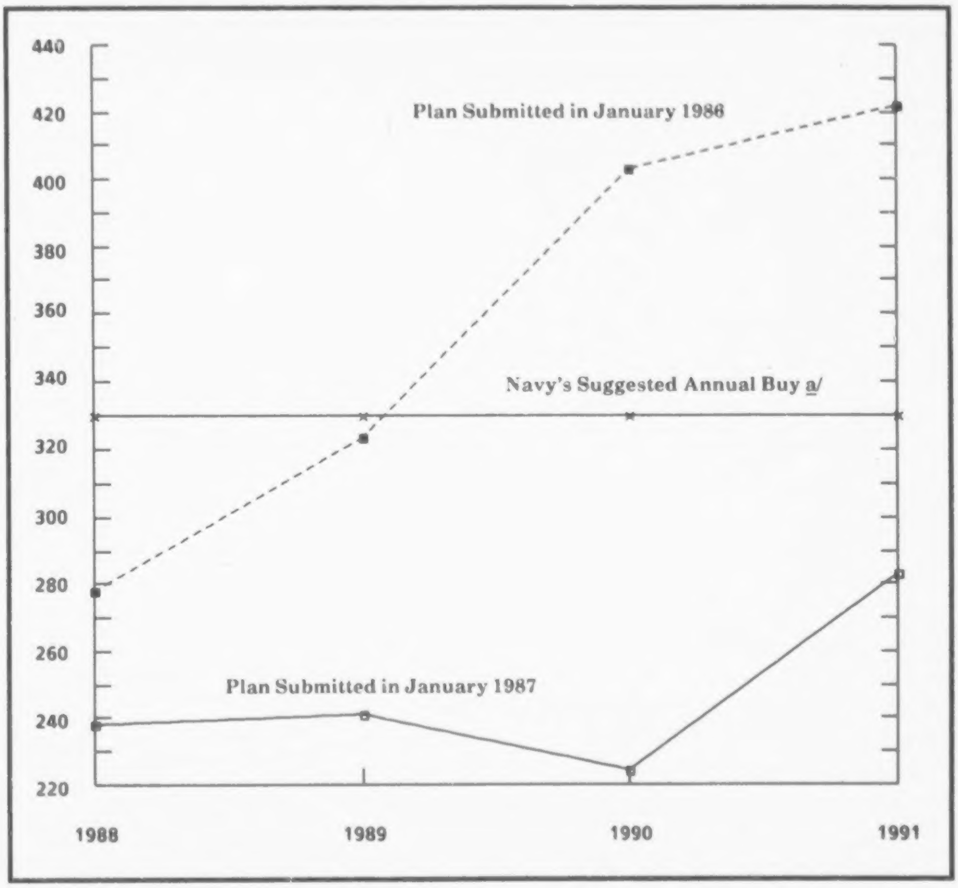
Aircraft	Quantity Short (Over)
F-14	12
F/A-18	18
A-6	69
AV-8	(17)
EA-6	30
E-2	(7)
S-3A	44
SH-60B	4
SH-60F	(1)
P-3	37
SH-2	12
CH-53	(17)
CH-46 and V-22	(4)
AH-1	(4)
Net Shortfall	176

SOURCE: Congressional Budget Office estimates based on data from the Department of the Navy.

of the degree to which expensive aircraft carriers are being fully utilized.

To what extent does a shortfall of 176 aircraft suggest underutilization? Some of the shortfall may simply reflect limits

FIGURE 5. NAVY'S PLANS FOR AIRCRAFT PROCUREMENT IN THE FOUR-YEAR PERIOD (1988-1991) COMMON TO THE LAST TWO FIVE-YEAR PLANS



SOURCE: Congressional Budget Office using data from the President's budgets for fiscal year 1987 and for fiscal years 1988 and 1989; and from the Department of the Navy's Naval Aviation Plan, 1986.

a. The Navy has testified that it needs to buy 330 aircraft annually to meet its force requirements and keep its aircraft at a constant average age.

associated with the size of aircraft carriers, which under some assumptions could not accommodate all the aircraft the Navy says it requires. The largest aircraft carriers (of the Nimitz class) can each accommodate 156 aircraft equivalent in size to the A-7E (the Navy's smallest fixed-wing carrier-based aircraft) if they fill the available aircraft parking space except for landing areas. Realistically, however, room must be left to move and service aircraft. A recent Navy study argued that a feasible loading would range from 75 percent to 85 percent of the maximum.[5] At a density of 75 percent, a Nimitz-class carrier could handle 117 aircraft equivalent to the A-7E, but the notional air wing used in deriving requirements contains 125 A-7E equivalents, as shown below.[6]

Aircraft	Number of Aircraft	Space Required (In A-7E equivalents) Per Plane	Space Required (In A-7E equivalents) Total
F-14	20	1.56	31.2
F/A-18	20	1.18	23.6
A-6	20	1.41	28.2
S-3	10	1.49	14.9
SH-60F	6	.60	3.6
EA-6	5	1.44	7.2
E-2	5	1.97	9.85
	86		118.5
Ground Support Equipment			6.5
Total			125.1

Considering carriers of various sizes in the Navy inventory, and assuming a density of 75 percent, requirements could contain 180

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5. Department of the Navy, "Carrier Air Wing Composition Study" (Final Report, December 1984), pp. 4-5, 4-6.

6. Congressional Budget Office estimates from data supplied by the Department of the Navy.

more aircraft than can fit on the carriers.[7] If requirements were reduced by 180 aircraft, there would be no shortfall in 1994.

On the other hand, all of the required planes could be accommodated at a density of 85 percent, though wings for smaller carriers would be smaller than the notional wing. In addition, the Navy would expect to use any "excess" planes that could not be deployed in peacetime to replace aircraft lost in war; so, even assuming the lower figure of 75 percent, requirements may be valid.

Apart from these limits on available deck space, the Navy can presumably accommodate some level of shortfall, as it is doing today. Moreover, it can probably do so in peacetime without deploying aircraft carriers, squadrons, or other units with fewer than their full complement of aircraft. Table 5 shows categories of requirements in 1994 for one type of aircraft (the A-6). About 67 percent of total required aircraft would be deployed or preparing to be deployed, and only about a third of those would actually be deployed (see note to Table 5 for the formula used to determine aircraft requirements). The remaining requirements are needed to keep combat squadrons equipped with planes while some are being repaired and modified (15 percent for the "pipeline"), testing new weapons and tactics (2 percent), and providing training for pilots who have never flown combat aircraft or who have not flown recently (15 percent). The Navy indicates that needs for deployed units can be met by removing planes from squadrons that have just returned from deployment and giving them to squadrons that are about to deploy (a technique known as cross-decking). The Navy also says that, at least temporarily, it can reduce the amount of time planes spend in routine maintenance or reduce planned modifications, thus freeing some aircraft in the pipeline for duty on deploying units.

These various accommodations, however, may reduce defense capabilities, particularly in wartime. Cross-decking of aircraft means they fly more in peacetime and thus age faster; indeed, cross-decking

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7. This figure assumes eight "notional" air wings (described above) and three standard wings. The Navy is currently making the transition from standard to notional wings, but three standard wings will remain in the fleet in 1994. The remaining carriers contain either Midway or Kennedy wing configurations.

TABLE 5. CATEGORIES OF AIRCRAFT REQUIREMENTS FOR THE A-6 IN 1994

Category of Requirement	Number of Planes	As Percent of Total
Deploying or Preparing to Deploy a/	352 b/	67
Maintenance and Modification ("Pipeline")	80	15
Additional Requirements		
Training squadrons for pilots with no recent flight experience in combat aircraft (Fleet Replenishment Squadrons)	81	15
Support of research and development and other miscellaneous requirements (RDT&E)	12	2
Total Requirements	525	100

SOURCE: Congressional Budget Office estimates based on data from the Department of the Navy.

NOTE: The formula widely used in the Defense Department to determine aircraft requirements is:

Requirement = (number of squadrons x number of aircraft) + training requirement + support for tactics and development (RDT&E) + maintenance requirements.

Each service uses its own percentages. The Navy, for example, when determining total aircraft requirements, uses the following percentages:

Training = 25 percent of primary aircraft authorization (PAA)
RDT&E = 3 percent of PAA + training
Backup = 15 percent of PAA + training + RDT&E

Each type of aircraft is assigned specific percentages to be used in this formula when determining requirements for a particular type of aircraft. Thus, the percentages shown in this table reflect the percentages for the A-6.

a. Includes aircraft deployed, just back from deployment, or in workup for next deployment (including squadrons coming up to full strength in personnel and squadrons at full strength).

b. Includes requirements for the Marine Corps and the Navy Reserve.

has been vigorously opposed by the Navy in the past. Reducing time in routine maintenance may also make planes wear out faster, and reducing the time for modifications decreases the Navy's ability to offset technological obsolescence by upgrading older planes to enhance their capabilities. Perhaps most important, in wartime the Navy would want to deploy immediately many units that, in peacetime, are in workup for deployment. Shortfalls that can be accommodated in peacetime may lead to units being deployed in wartime without all their assigned aircraft. Shortfalls would also mean that fewer spare planes would be available to replace aircraft damaged in combat.

Thus, aircraft shortfalls are best interpreted as exacerbating problems of aging and maintenance in peacetime and as suggesting underutilization of an expensive asset, and hence reduced capability, in wartime.

Larger Shortfalls Possible

Shortfalls of naval aircraft could be much larger, and thus presumably much less manageable, under different assumptions about how long aircraft can remain in service. The shortfalls above reflect aircraft retirement plans that the Navy provided the Congressional Budget Office (CBO). For the group of aircraft discussed here, these "retirement ages," as the Navy calls them, would indicate that the Navy expects the average aircraft to remain in service about 26 years (see Table 6). Earlier the Navy provided CBO with "service life" estimates that assumed shorter time in service, averaging 23 years. (Both estimates exceed the 20-year figure used in the Naval Aviation Plan, and average ages of fighter/attack aircraft exceed the 15-year figure presented in earlier Navy estimates.)

A different picture from that discussed above emerges if service lives are used. By 1994, shortfalls under the Navy's assumptions of service life would total about 592 aircraft, or about 17 percent of the total inventory. Shortfalls of this magnitude would exceed the entire number of aircraft assumed to be in repair and would presumably greatly exceed the shortfall that the Navy could accommodate without significant underutilization of aircraft carriers in peacetime and wartime.

Which are the right ages to assume? As discussed earlier, the Navy has argued that older planes run the risk of obsolescence in the face of increasing threats, are more expensive and less efficient to operate, and are expensive to modify. The shorter service lives would seem to reflect these concerns and, indeed, may be evidence of

TABLE 6. NAVY ESTIMATES FOR AIRCRAFT RETIREMENT AGES

	Navy Estimates (In years)	
	Retirement Age a/	Service Life b/
F-14A	27	18
F/A-18	16	15
F-4	19	19
A-7E	17	17
A-6	32	23
AV-8B	15	15
AV-8A and AV-8C	13	13
A-4	33	32
EA-6	37	20
E-2	21	17
S-3A	24	24
SH-3 and SH-60F	29	23
P-3	30	30
SH-60B	22	22
SH-2F	34	24
CH-53	28	28
CH-46E and V-22	33	33
AH-1J, AH-1T, AH-1W	30	30
Weighted Average c/	26	23

SOURCE: Congressional Budget Office estimates of retirement ages and service lives supplied by the Department of the Navy, using weighted average in some cases.

a. Supplied by the Navy in March 1987.

b. Supplied by the Navy in February 1987.

c. Ages weighted by number of aircraft in the 1987 inventory.

problems associated with the aging of the fleet. In 1985 about 60 percent of the A-6 fleet was grounded or could only fly on a restricted basis because of problems with wing fatigue that may be related to aging. Moreover, planes now being retired--F-4s and A-7s--appear to have had lives more consistent with the 23-year plans than the longer ones (though the Navy is retiring some A-7s with service life remaining). Finally, last year's procurement plans appeared to assume the shorter service lives, since the older retirement ages yield an overage of 217 aircraft, if the deliveries associated with last year's plan are assumed.

On the other hand, aircraft can be modified to extend their service lives almost back to the level of new aircraft. Indeed, the Navy has such programs for the A-6 and the F-14--programs that are apparently not reflected in the shorter service lives averaging 23 years but are reflected in the longer retirement ages averaging 26 years. Moreover, even new planes, like the F/A-18, have been grounded in the past for unanticipated problems with structural fatigue. Thus, the current grounding of the A-6 may be related more to the rigors of flight and the difficulties of estimating structural fatigue than to the age of the plane.

What is clear is that assumptions about age of aircraft at retirement critically affect the size of future shortfalls. The Navy will not know for sure if the longer retirement ages are acceptable until time passes and the condition of aircraft at various ages can actually be assessed. In the meantime, the risk of substantially larger shortfalls cannot be ignored.

AFFORDABILITY OF CURRENT PLANS

Under present plans, funding in the Navy's aircraft procurement account is scheduled to grow from \$10.0 billion to \$15.7 billion over the next five years (see Table 7). In real terms, funding for the account is lower in 1988 and 1989 than it was in 1987. Nonetheless, between 1987 and 1992, real growth in the Navy's aircraft procurement account is currently projected to average 7 percent a year over the next five years. As Table 7 shows, real growth is particularly high in 1990. Much of this growth stems from the addition of funding for the new V-22 tilt-rotor aircraft and the restarting of procurement of a long-range ASW aircraft.

The Navy will have difficulty financing this plan. Without changes in its own budget priorities, achieving this plan means the Navy would have to receive a growing share of the total DoD budget. The Administration's plans call for average annual real growth of 3 percent in the DoD budget over the next five years, while the latest Congressional budget resolution calls for annual real reductions averaging as much as 2.4 percent over the three years covered by the resolution (1988-1990). Increasing the Navy's share may be difficult, however, since the Navy has not received a higher percentage of the budget than its current share--about 34 percent--since at least 1951.

TABLE 7. FIVE-YEAR PROCUREMENT COSTS FOR NAVY AIRCRAFT, FISCAL YEARS 1988-1992 (In billions of dollars)

	1987 Actual	Current Five-Year Plan					Total (1988-1992)	Average Annual Real Growth 1987-1992 (In percents)
		1988	1989	1990	1991	1992		
Combat Aircraft a/								
Current dollars	5.9	6.4	6.9	8.4	9.4	10.3	41.5	
Constant 1988 dollars	6.1	6.4	6.7	7.9	8.7	9.3	39.1	9
Total Aircraft								
Current dollars	10.0	9.9	10.3	12.5	13.6	15.7	62.0	
Constant 1988 dollars	10.3	9.9	9.9	11.8	12.6	14.1	58.4	7
Real Growth Over Preceding Year (In percents)	-1	-4	0	19	6	13	n.a.	n.a.

SOURCE: Congressional Budget Office estimates from the Department of the Navy.

NOTE: n.a. = not applicable.

a. Includes funding for F-14D modifications but excludes funding for other aircraft modifications, spares and repair parts, aircraft support equipment, and facilities.

Moreover, DoD has stated that strategic nuclear forces have the highest budget priority and might therefore be assumed to absorb a larger share of funds if budgets are cut.

The Navy could also accommodate growth in aircraft costs by reallocating funds within its own budget, allowing more growth for aircraft and less for other activities such as operating costs, research, or ship construction. And it may indeed be reasonable to assume that the aircraft share of the Navy's budget will grow, since it is substantially below shares that it has had in the past. In fact, funding for aircraft procurement as a percentage of the total Navy budget has declined every year since 1982.

On the other hand, the aircraft account would have to increase its share at the expense of other Navy programs that may also need to grow. For example, the Navy's shipbuilding plan calls for substantial real growth to sustain the 600-ship Navy with technically advanced ships. Furthermore, the Navy's operating budget may not be able to reduce its budget share. Preliminary results of a CBO study on DoD's operating and support costs indicate a historical link between the value of capital stock and the costs to operate that stock. The Navy's capital stock is scheduled to grow by 3 percent per year through 1992, indicating some pressure for increases rather than decreases in funds to operate the Navy.

Clearly, the Navy will have difficulty funding its aircraft plan given the current fiscal outlook for defense spending. That task assumes Herculean proportions if the Navy decides it needs to meet the aircraft shortfalls identified above. Meeting the 1994 shortfall of 176 aircraft discussed above could add a total of $7 billion to aircraft procurement costs over the next five years. Assuming that those added costs were spread evenly over the next five years, annual real growth in Navy aircraft procurement costs would amount to 8.5 percent a year rather than 7 percent under the Administration's plans. If current retirement plans prove overly optimistic, and the Navy reverts to the service life estimates in its own planning documents, then the shortfall would grow to 592 aircraft. The costs to meet such a shortfall would total $24.9 billion. It would probably be infeasible to procure enough extra aircraft over the next five years to meet such a large shortfall. But, to place these added costs in context, real growth in aircraft procurement would have to average 13 percent a year if a shortfall of 592 aircraft were to be made up in five years.[8]

These added costs of shortfalls are intended as rough approximations, not as alternative budgets. The costs generally assume that planes are bought at the same unit price that the Navy expects to pay for them in 1992, deflated to 1988 dollars. This unit price implies that shortfalls are met by extending procurement at currently planned rates; costs would be lower if shortfalls were met by increasing production rates. These estimates are not based on year-by-year costs, which would take into consideration other factors such as learning-curve effects.

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[8] This percentage assumes that planes could be added evenly in every year. Since some of the shortfall includes planes no longer in production, lines would have to be started and real growth in costs toward the end of the planning period would be higher.

CHAPTER IV

ALTERNATIVES TO THE ADMINISTRATION'S PLANS

The preceding chapter suggested that, even under the Administration's plans, the Navy faces some difficult choices regarding naval aircraft. It could face shortfalls of aircraft, perhaps substantial ones, in addition to the possible need to reallocate funds to pay for a plan that requires aircraft spending to average 7 percent annual real growth.

Those choices become much more difficult if one assumes that the Navy will receive substantially less funds than it plans for naval aircraft. Yet, with the latest Congressional budget resolution calling for real reductions in total DoD funds, that assumption is quite plausible.

This chapter addresses four alternatives to the Navy's aircraft plans. These alternatives were constructed to illustrate the possible consequences of limiting funding for naval aircraft procurement and are intended to reflect possible Congressional and Administration actions, not to cover the universe of available choices. Thus, all of them generate savings over a five-year period equal to the savings that would result from maintaining a level of zero real growth in aircraft procurement, compared with the growth planned by the Administration. Zero real growth was chosen solely to allow the study to illustrate specific options; the Congress may well choose a higher or lower figure.1/ The options include some cases in which growth is higher or lower than zero in some years, and in which savings appear in accounts other than aircraft procurement.

The Navy's aircraft procurement account--technically known as the Aircraft Procurement, Navy (APN) account--contains funds for

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1. The Congressional Budget Office baseline for 1988 through 1992 assumes zero real growth in defense budget authority for each of the next five years. Similarly, within the baseline, zero real growth was assumed in the Navy's aircraft procurement account.

aircraft other than the combat aircraft dealt with in this study. Funding in other categories of the account (including those for trainer and transport aircraft and for spares and modifications of existing aircraft) is already projected in the Navy budget to receive less than the amount associated with zero real growth. Since it may be difficult to fund the modifications and spares needed within this diminished amount of funding, the analysis did not attempt to cut further this portion of the account.

The four options illustrate various combinations of the following basic choices facing the Navy:

- How many deployable aircraft carriers to maintain;
- Whether or not to reduce shortfalls of aircraft; and
- Whether to reduce costs by cutting back on procurement of existing aircraft, or by delaying or canceling new programs.

Specifically, Options I and II maintain the Administration's plans for numbers of aircraft carriers and air wings (force structure). Option I finds the needed saving by reducing aircraft procurement evenly, while Option II defers the V-22 program for three years and cancels the A-6F modification program. Both of these options increase shortfalls. Options III and IV reduce force structure, which eliminates the underutilization suggested by shortfalls and produces operating savings. Option III saves the remaining funds by an across-the-board cut in the aircraft account, and Option IV delays the LRAACA program slightly and cancels the A-6F improvements.

OPTION I. MAINTAIN 15 CARRIERS BUT BUY FEWER AIRCRAFT AND DELAY RETIREMENTS

This alternative generally exemplifies recent actions taken by the Navy to cut costs. For example, last year the Navy reduced its planned 1988 aircraft funding to reflect new and lower planning targets. During that cutback, the Navy maintained its plan to have 15 deployable aircraft carriers--one of its highest priorities--and continued procurement of all types of aircraft rather than cancel any systems. Planned quantities, however, were reduced in roughly half of the aircraft lines, while other lines continued at 1987 levels. This sort of cut has the appeal of spreading the pain evenly and may be more politically viable than plans to cancel systems. But as this alternative will show, it is also costly because aircraft bought in smaller quantities are more expensive.

Specifically, the alternative would cut proportionately from all aircraft lines the $6.9 billion needed to attain zero real growth over the next five years. The Navy would buy 306 fewer planes than the Administration's program (see Table 8). In order to limit increases in the aircraft shortfall, the alternative would raise retirement ages--another apparent Navy strategy in the face of funding reductions.

By design, for this approach the savings of $6.9 billion for the 1988-1992 period were taken from the aircraft procurement account (see Table 9). No savings were assumed for 1988 and 1989 because funding in these years is lower than in 1987 and because it seemed reasonable, for such a pro rata reduction, to delete the required savings from years that exceeded zero real growth.

This alternative has the advantage of maintaining the 15 deployable carriers and their accompanying 14 active air wings (a reserve air wing would be activated in wartime to accompany the fifteenth deployable carrier).2/ The Navy feels this is the minimum number needed for peacetime presence and to pursue such wartime strategies as the forward offensive strategy. The alternative would also continue improving the capabilities of the fleet by introducing new aircraft systems and modifications to older aircraft, including the A-6F upgrade. Introductions would be slowed modestly, however, because new aircraft would suffer the same pro rata reductions as other aircraft. Finally, all production lines would remain open, providing a larger production base in the event of war.

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2. A sixteenth carrier is expected to be undergoing a service life extension program (SLEP) for the foreseeable future. The second reserve air wing would eventually be attached to this carrier, though activating the carrier could take some time.

TABLE 8. COMPARISON OF THE ADMINISTRATION'S PLAN AND ALTERNATIVES

Plan/ Alternative	Number of Carriers	Net Aircraft Shortfall (Overage)		Average Age of Naval Combat Aircraft in 1994 (In years)				Range of Increase in Unit Costs Above Those in Administration's Plan, 1988-1992 (In percents)	Decrease in Number of Aircraft Bought 1988-1992 Relative to Administration's Plan
				All Aircraft		Fighter/ Attack			
		1987	1994	1987	1994	1987	1994		
Administration's Plan, 7 Percent Real Growth	15	111	176	12.2	12.9	10.6	10.3	n.a.	n.a.
Zero Real Growth Alternatives									
Option I: Reduce Procurement Evenly; Delay Retirements	15	111	361	12.2	14.2	10.6	11.4	7 to 82	306
Option II: Delay V-22 Three Years; Cancel A-6F Modification	15	111	216	12.2	13.6	10.6	10.6	n.a.	118
Option III: Reduce Force Structure; Reduce Procurement Evenly	13	(88)	(2)	12.2	13.4	10.6	10.6	2 to 12	81
Option IV: Reduce Force Structure; Cancel A-6F Modification; Delay LRAACA	13	(88)	(52)	12.2	13.3	10.6	10.4	n.a.	36

SOURCE: Congressional Budget Office using data from the Department of the Navy.

NOTE: n.a. = not applicable.

TABLE 9. DERIVATION OF SAVINGS UNDER ALTERNATIVE APPROACHES (In billions of dollars)

		1988-1992		
Option	1988	Five-Year Total	Aircraft Procurement	Operating and Support a/
I	0.0	6.9	6.9	0.0
II	0.2	6.9	6.9	0.0
III	0.6	6.9	1.8	5.1
IV	0.8	6.9	1.8	5.1

SOURCE: Congressional Budget Office (CBO) estimates from the President's budget for fiscal years 1988 and 1989, and Selected Acquisition Reports (various submissions). Operating and Support savings were derived using CBO's Defense Resources Model.

a. Includes the accounts that fund military personnel and operation and maintenance, as well as small amounts in the procurement and development accounts that relate to the annual operating costs of the carriers and air wings.

By 1994, however, aircraft shortfalls under this option would be roughly double those under the Administration's plan--361 aircraft instead of 176. For some types of aircraft, even reducing retirements to zero would not be sufficient to compensate for procurement reductions under this option. Despite the larger shortfall, the Navy may still not be forced to deploy carriers with fewer aircraft in peacetime than their normal operating complements. The Navy may still be able to transfer or cross-deck enough aircraft from peacetime carriers just returning from deployment to avoid sailing short of planes.3/ Nonetheless, the increased shortfall suggests more underutilization of aircraft carriers, especially in wartime.

Delaying the retirement of planes drives up the average age of the fleet. By 1994, the average age of the Navy's combat fleet would be 14.2 years compared with 12.9 years under the Administration's

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3. Alternatively, one could keep the shortfall close to the Administration's level, but then aircraft funding would grow by about 3 percent a year in real terms.

program. Thus, though the alternative would begin to enhance the capabilities of some portions of the fleet by introducing aircraft with new technology, the overall capabilities of the fleet could become more obsolete.

Finally, proportional cuts would result in less efficient procurement because the unit costs of planes bought at lower quantities would be higher--in some cases substantially higher. Based on CBO's analysis of budget data, unit cost increases for planes bought under this alternative would range from 7 percent (for the E-2C) to 82 percent (for the V-22 aircraft).4/

OPTION II. MAINTAIN 15 CARRIERS BUT DELAY NEW PROGRAMS

If proportional cuts increase production inefficiencies and yield an older fleet, why not fund some programs more fully while delaying others? This general strategy--though not necessarily the specifics of this option--has been suggested by the Senate Committee on Armed Services as a way to improve efficiency in defense procurement.

As an example of such a strategy, this alternative would delay the start of V-22 aircraft procurement for three years; research funding would continue at planned levels to preserve the option of later procurement. As discussed in earlier chapters, the V-22 is a tilt-rotor aircraft that the Marine Corps plans to use to transport personnel and equipment from ship to shore. This option would also cancel the modification program planned for the A-6 aircraft. Instead of the new A-6F aircraft with improved radar, enhanced avionics, and a new engine, this option would continue procurement of the current A-6E at planned rates. The alternative would, however, maintain 15 deployable aircraft carriers and 14 air wings and so would meet Navy requirements.

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4. The unit cost increase for the V-22 is high because the plane is in the early stages of production where small decreases in production yield large increases in costs and because the V-22's share of combat aircraft funding is large--an average of about 25 percent in the three-year period from 1990 through 1992. Hence, its pro rata share of the cut is also large.

Not buying V-22 and A-6F aircraft would save the requisite $6.9 billion in procurement to attain zero real growth. Therefore, at approximately the same funding level, this alternative buys 188 more planes than Option I. As a result, by 1994 the shortfall of aircraft is much smaller (216 aircraft compared with 361) and the fleet is younger (averaging 13.6 years in 1994 compared with 14.2). Thus, the alternative achieves more and younger aircraft at the expense of delayed technological improvements caused by slowing production of the V-22 and canceling the A-6F modifications.

On the other hand, this alternative also retires some planes later than the Administration's program in order to limit increases in the shortfall (which still grows to 216 aircraft in 1994). Thus, the average age of the fleet under this option is 0.7 years higher than under the Administration's program. And, because delaying retirements is not sufficient to compensate for some shortfalls, the shortfall would be 40 planes higher than under the Administration's program.

Delaying the V-22: Pros and Cons

Delaying the V-22 aircraft may have some advantages. As discussed earlier, Members of the Congress and the Administration have criticized the program, expressing concerns about expense, complexity, and about how well V-22 capabilities mesh with those of other systems performing the amphibious assault mission. The Department of the Navy itself delayed procurement of the first planes from 1989 to 1990 in the President's budget submission for fiscal year 1988, although the Marine Corps argues that this delay was caused by cost negotiations with the contractor rather than development problems.5/ Nevertheless, a delay of this sort in other defense programs has frequently been an indication of development problems; if this is the case,

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5. Former Secretary of the Navy John Lehman wanted development funded under a firm fixed-price concept, with the developers being responsible for cost overruns. The Bell/Boeing team wanted a cost-plus-incentive contract, with the Navy absorbing much of the risk. Apparently the Navy eventually agreed to a fixed-price incentive contract under which risk of cost increases is shared. The Marine Corps also argues that this delay will not in turn delay the fielding of the V-22, though fewer V-22s will be in the fleet in the near term under the delayed program.

delaying the V-22 program for another three years should provide ample time for it to reach maturity before entering production.

On the other hand, the Marine Corps has argued that the number of CH-46s will be lower than service requirements if the V-22 program is delayed. Indeed, this alternative would yield a shortfall of 111 planes in 1994 for the Marine Corps' medium-assault mission. In contrast, the Administration's program would yield a slight overage of four planes. Growth in the shortfall stems in part from expected losses of CH-46 helicopters during peacetime training accidents but more from the increases in the number of aircraft required in the Marine Corps' medium-lift squadrons so they can respond to the Corps' greater need to transport troops and equipment. Under the Administration's plan, the Marine Corps would begin meeting its increased requirements in the early 1990s; under this option, it would not begin meeting them until the mid-1990s, and hence the Corps would have less airlift capability for its amphibious forces for a few years. The Corps has expressed particular concern about whether it will have the lift to transport the High Mobility Multi-Wheeled Vehicle (HMMV) that has been bought in quantity as a replacement for the jeep. The CH-46s cannot carry HMMVs but CH-53s and V-22s can, and the Marine Corps argues that CH-53E inventories are already insufficient and will become more so during this time period.

Canceling A-6F Modification: Pros and Cons

Canceling the A-6F program and continuing A-6E production is consistent with the argument that the A-6F will not solve the key problem with the A-6E and will be rendered obsolete by the Advanced Tactical Aircraft (ATA). The A-6E is a large aircraft that is easily detected by enemy radar and so does not have a high probability of survival against a capable enemy. Although the A-6F would have improved avionics that would increase its survivability, that survivability would probably not be fully enhanced without a new airframe that incorporates radar-evading or stealth characteristics, such as those planned for the ATA. Thus, this approach avoids the added cost of the A-6F, which may add little to capability. This option is a conservative version of the one proposed earlier this year by the Senate Committee on Armed Services; the committee terminated all

A-6 procurement in light of planned procurement of the Advanced Tactical Aircraft. The House continued the A-6F program.

On the other hand, unless the ATA experiences much higher procurement than is typical for Navy aircraft programs, the Navy will depend on the A-6 for many years. The A-6F would provide some improvement in capability until a large number of the Advanced Tactical Aircraft was available.

OPTION III. ACCEPT 13 DEPLOYABLE CARRIERS, REDUCE AIRCRAFT PROCUREMENT EVENLY

Given the magnitude of the aircraft shortfalls under the two previous options, the Navy's plan to deploy 15 aircraft carriers and 14 air wings may not be feasible. This is especially true if the Navy's plans for increasing retirement ages, and the even greater increases associated with the alternatives, prove optimistic (see Chapter III). If the Navy's estimated service lives--discussed in that chapter--were used, aircraft shortfalls under the previous options would be about 707 to 877 aircraft. Thus, this alternative evaluates retiring the two smallest carriers--the Midway and Coral Sea--in 1988 and at the same time reducing the number of air wings to 12, the force level of the early 1980s. When the Abraham Lincoln (CVN-72), which is now under construction, enters the fleet in 1990, the number of carriers would increase to 13 and would be held at that level. (To maintain that level, this alternative would also retire the Forrestal in 1992, when the George Washington (CVN-73), now under construction, enters the fleet.) Table 10 shows the numbers of carriers and air wings under the Administration's plans and Options III and IV.

This option is more consistent than the previous two with the suggestions of critics who doubt that the Navy would pursue the aggressive forward strategy in a major war against the Soviet Union. The risk of losing valuable carriers, or of provoking the Soviet leaders into a nuclear conflict, argue against such a strategy, as do concerns about the utility of the attack. Instead, critics see carriers playing a role on the periphery of a major war, which might be accomplished with 13 such ships.

Early retirement of carriers would achieve most of the savings necessary to reach zero real growth in the aircraft procurement account. The early retirements would save a total of $5.1 billion over the next five years (including $0.6 billion in 1988) in the operating and support accounts. If this amount was applied to offset increases in aircraft procurement costs, only another $1.8 billion in savings over five years would be needed to achieve zero growth. Under this option, those savings would be achieved by pro rata reductions of buys of all aircraft, resulting in 81 fewer aircraft being bought than under the Administration's plan.

Nevertheless, purchases of aircraft would be sufficient to meet the reduced requirements associated with 13 aircraft carriers and 12 air wings. In fact, by 1994, there would be a slight overage of aircraft (about 2 planes), though there would be shortfalls of some types of aircraft offset by excesses of others. Thus, this alternative would provide full aircraft capability to a smaller carrier force.

TABLE 10. FORCE STRUCTURE UNDER THE ADMINISTRATION'S PLAN AND OPTIONS III AND IV

	1988	1989	1990	1991	1992 a/
		Deployable Aircraft Carriers			
Administration	14	14	15	15	15
Options III, IV	12	12	13	13	13
Difference	-2	-2	-2	-2	-2
		Active Carrier Air Wings			
Administration	14	14	14	14	14
Options III, IV	12	12	12	12	12
Difference	-2	-2	-2	-2	-2

SOURCE: Congressional Budget Office.

a. The Administration plans to retire the Coral Sea late in 1992 when CVN-73 is fielded; Options III and IV, which retire the Coral Sea in 1988, would retire the Forrestal in 1992.

Procurement under this option also would enable the Navy to retire some of its planes earlier than under the other options. The average age of all naval combat aircraft (13.4 years in 1994) would be lower than under the previous two alternatives (13.6 years and 14.2 years), though slightly higher than the Administration's plan (12.9 years). The alternative would also continue to buy the new technology systems and to make the modifications the Navy envisions for its aircraft, though at slightly reduced rates. Hence, the alternative produces a smaller but more capable fleet.

Despite these advantages, this option does not produce the numbers of carriers and aircraft that the Navy believes are the minimum acceptable. Thus, in a major war the Navy would probably not have the forces to pursue the forward offensive strategy without great risk, since critics of the strategy question whether even 15 carriers would be sufficient. To the extent that the Navy is correct in assuming that the forward strategy would force the Soviet Union to withhold forces that might be used to attack other U.S. forces--especially convoys--this alternative might endanger the resupply of Europe. Or, if the Navy chose to pursue a forward strategy even with fewer carriers, it might have to decide between theaters, reducing strategic flexibility.

In peacetime, having fewer carriers could also mean that fewer were deployed overseas; 13 carriers might be able to support only about four deployed carriers instead of the five now planned. Naval forces with fewer carriers might be less able to respond in a crisis, if carriers based in the continental United States have to steam to trouble spots. Furthermore, if five carrier battle groups on average are kept at sea, the greater time at sea required of Navy personnel might cause retention rates to drop. Having to spend more time at sea may have contributed to the Navy's retention problems in the late 1970s and in 1980.

Finally, this alternative would cut procurement across the board, rather than select a few programs to defer or cancel, while keeping others at high production rates.6/ Thus, the option can be criticized for the same inefficiencies discussed in Option I, though to a lesser

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6. In general, cuts were apportioned to programs based on their share of the aircraft procurement account. For a small percentage of the savings, cuts were taken against the four aircraft lines that had the largest share--totaling about 70 percent--of funding.

degree. CBO estimates from budget data suggest that unit costs of aircraft would increase under this option by between 2 percent and 12 percent.

OPTION IV. ACCEPT 13 DEPLOYABLE CARRIERS, CANCEL NEW PROGRAMS

This option would attempt to respond to the inefficiency of higher unit costs by limiting the number of programs affected by the cuts. As in the previous option, carriers would be retired early. Because of the large operating savings afforded by early retirement of carriers, smaller cuts could be made in other programs while still achieving zero real growth. Specifically, the A-6F program would be canceled, though A-6E procurement would continue at the Administration's planned levels. The LRAACA program would be delayed by one year, and procurement in the second year of the program would be reduced from 25 to 14. As with previous options, the alternative would delay some retirements slightly to minimize shortfalls.

Because force requirements are reduced, this option eliminates the aircraft shortfall and even produces an overage of about 52 planes by 1994 (see Table 8). (The overage could be avoided only by assuming retirements for the F/A-18 at ages earlier than those under the Administration's plan. As the Administration already assumes lower retirement ages for the F/A-18 than for other fighters, this assumption did not seem reasonable.) Thus, the alternative completely supports the smaller force structure.

The alternative would also produce the youngest force of any of the four options. In 1994, the average age of naval combat aircraft would be 13.3 years, close to the Administration's average age of 12.9 years. Moreover, this option would continue the V-22 aircraft program on its current development schedule, thus providing the Marine Corps with the improvements in technology it feels it needs. Finally, Option IV would buy most aircraft at the rates planned in the Administration's budget, and hence would not increase their unit costs.

A delay of the LRAACA program may prove necessary. Some analysts have argued that the three-year development program is too short and that the Navy has not developed a clear plan for its long-range ASW aircraft needs. In particular, both House and Senate Armed Services Committees called for the Navy to submit plans for the ASW requirements (though both committees provided funding for a long-range aircraft). The one-year delay envisioned here would give the Navy more time to develop the systems that are integral to the program and to consider various alternatives in more detail.

On the other hand, the alternative can be criticized for not meeting the Navy's stated requirements for aircraft carriers. Nor does it provide improvements in the A-6 aircraft as a hedge against delays in the Advanced Tactical Aircraft that will eventually replace the A-6. And even this slight delay in the LRAACA program may cause concern in the Navy. The service has argued that ASW improvements are currently a very high priority because of the quieting of Soviet submarines.

CONGRESSIONAL ACTION TO DATE

As this study goes to press, Congressional action is proceeding on the President's budget for fiscal years 1988 and 1989. A conference committee of the House and Senate has completed action on a bill authorizing defense appropriations for 1988 and for some programs in 1989, while the House Committee on Appropriations has issued a proposed bill appropriating funds for 1988. Because actions are not completed, they are not reflected in the details of this study; Administration plans in this study are consistent with the President's budget proposals found in the submission for 1988 and 1989.

Some actions being considered by the Congress could affect the relevance of the options in this study. For example, the conference agreement on the defense authorization bill would, under its so-called "low tier," terminate funding for the A-6 aircraft (both existing A-6E aircraft and the program to develop the A-6F) and the AV-8B aircraft. Together those actions would achieve savings ($7.3 billion in the years 1988 to 1992) sufficient to keep growth in the Navy's aircraft procurement account slightly below zero in real terms. Thus, the Congress would not need to take any of the other steps to achieve zero real growth discussed earlier in this chapter.

On the other hand, the actions contemplated in this low tier would exacerbate aircraft shortfalls in ways that could lead to further debate about funding of naval aircraft. There would be fewer A-6 and AV-8B aircraft under the low tier but no large additions to other types of aircraft. If there are no changes in requirements, shortfalls by 1994 would rise from 176 aircraft under the Administration's plan to about 380 aircraft under this low tier. Coupled with strong service support for programs such as the AV-8B, this shift may well prompt continued debate.

Moreover, final Congressional action may not include far-reaching steps such as termination of aircraft programs. The termination of the A-6 and AV-8B programs occurs only under the low tier of the authorization bill. That low tier applies if total appropriations for the national defense function (function 050) equal $289 billion of budget authority or less. If the final appropriation is higher, a high-tier authorization applies that does provide funding for an A-6 program and AV-8B aircraft. Moreover, the appropriation bill proposed by the House Committee on Appropriations provides funding for both these aircraft.

It is virtually certain that the Congress will make changes in the 1988 budget that will affect detailed costs of options in this study. It seems much less likely that Congressional action will resolve naval aircraft issues. If the debate over affordable ways to meet needs for naval aircraft continues, it is likely to reflect generic options of the sort discussed in this study.

CHAPTER V

LONG-TERM BUDGET PRESSURES

Pressures on the Navy's budget may last well beyond the five-year period discussed in the preceding chapters. Two new planes to replace the A-6 and the F-14 are already being developed. Funding their procurement could prove to be expensive under all but the more optimistic assumptions. Nor does it seem likely that the shipbuilding account, the other major procurement account in the Navy's budget, will be able to finance higher aircraft costs, because a large block of carriers reaches retirement age early in the next century. This chapter discusses potential budget pressures associated with the Navy's long-term plans for aircraft.

These long-term pressures are of more than academic interest. Completing all the steps involved in the design of a state-of-the-art military aircraft can take a decade or more. Yet many of the decisions that influence costs are made relatively early in that process. Thus, if the Congress waits until it faces procurement decisions regarding these two new Navy aircraft, its only realistic choices will be when to begin procurement and how quickly to buy the planes. On the other hand, at this early stage in the process, the Congress could apply pressure to hold down costs, though classification levels for one of the programs may make monitoring its costs difficult.

THE NEW AIRCRAFT

The Navy is currently developing two new aircraft to replace the A-6 and the F-14--the Advanced Tactical Aircraft (ATA) and a version of the Air Force's Advanced Tactical Fighter (ATF).1/

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1. For additional information on the ATA and ATF, see Bert H. Cooper, Jr., *Advanced Tactical Aircraft (ATA) Program* (Weapons Facts), and *Advanced Tactical Fighter (ATF) Aircraft* (Weapons Facts), Congressional Research Service, October 15, 1987.

The Advanced Tactical Aircraft

The ATA, originally intended to replace both the A-6 attack aircraft and the F-14 fighter/interceptor aircraft, is now apparently being developed with only an attack mission in mind. Though official details about the ATA--including costs, procurement schedules, and capabilities--are not publicly available, the Navy has provided some general information. The Navy plans for the ATA to have the long range and large payload needed for attack aircraft. In addition, since the A-6 has been criticized for not being sufficiently survivable in an increasingly hostile combat environment, the ATA will emphasize "stealth" technology. A stealthy plane employs a variety of techniques to decrease its visibility to enemy sensors. The Navy has also said that it would like the ATA to be more maneuverable than the A-6 to enhance its ability to avoid enemy fighters and missiles. Timing of the deployment of the ATA program is closely held, but former Secretary of the Navy John Lehman has indicated that it is similar to that of the Air Force's ATF, which will be fielded in the mid-1990s.

Navy estimates of ATA costs, which are very tentative, vary from about the same as those of the A-6E, according to testimony by a former Deputy Chief of Naval Operations, to about 60 percent higher based on a press release by former Secretary Lehman.2/ Program quantities, about 450 according to the Secretary, would seem to indicate a one-for-one replacement of the A-6.

The Navy Variant of the Advanced Tactical Fighter

Concerns about affordability, and perhaps a desire to respond to Congressional pressure for more joint development, led the Navy and Air Force to announce that they plan to buy variants of each other's

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2. Testimony by Vice Admiral Edwin H. Martin, Deputy Chief of Naval Operations for Air Warfare, before the Tactical Warfare Subcommittee of the Senate Committee on Armed Services, on the fiscal year 1986 budget, and a DoD news briefing by Undersecretary of Defense for Research and Engineering Donald Hicks, Secretary of the Navy John Lehman, and Secretary of the Air Force Russell Rourke, Thursday, March 13, 1986. Neither of these sources is very specific. In particular, the admiral stated that he expected the ATA to "be in the same ball park as the F/A-18 and A-6." Secretary Lehman said that, while the Navy was not declassifying costs for the ATA, he did not expect its costs to exceed those of the ATF.

planes. The Navy now plans to buy some version of the Air Force's Advanced Tactical Fighter as a replacement for the F-14, while the Air Force will use a variant of the ATA to replace its medium-attack aircraft, the F-111.

An earlier Congressional Budget Office study detailed the many improvements that the Air Force would like in its ATF.[3] Presumably they would also be present in a Navy version. The improvements include:

- Enhanced avionics to assist the pilot in locating and attacking targets;
- Stealth technology to make the aircraft less visible to radars and infrared detectors;
- Ability to maintain supersonic speed over long ranges;
- Long ranges to allow the aircraft to be based far away from enemy attackers;
- Ability to take off and land on short runways;
- Easy maintainability and higher reliability than current aircraft; and
- Higher chance of the crew surviving in areas contaminated by chemical or biological agents.

The Navy has said that it plans to buy a combined total of about 1,000 of the ATA and Navy ATF. Assuming that the Navy buys 450 ATAs, as suggested above, procurement of the Navy ATF would total about 550--about 100 planes more than its F-14 inventory. Former Secretary Lehman, however, called for procurement of only enough Navy ATFs to replace F-14s on a one-for-one basis. Thus, the exact size of the buy either is not publicly available or has not yet been determined.

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3. Congressional Budget Office, *Tactical Combat Forces of the United States Air Force: Issues and Alternatives* (April 1985).

The timing of the Navy's ATF program is even less clear than that of the ATA, though the Navy has indicated that it might begin in the late 1990s.[4] A schedule that assumes that procurement of the Navy ATF begins around 1998 or 1999 would match the time when the F-14 would begin to retire in large quantities, based on current Navy estimates that the F-14 will have a service life of 27 years.

Costs of the Navy ATF are also highly uncertain, in part because of changes that may have to be made in a Navy version of that plane. A Navy ATF would have to be modified to be able to land and take off from a carrier. Depending on how closely the services coordinate their requirements during development, this modification could mean a major redesign effort, though the Navy is apparently hoping that the two planes will be about 90 percent common. Indeed, difficulties in achieving a common design have led to problems in past joint programs and could eventually lead the Navy to develop its own follow-on fighter, a move that might increase costs.[5]

Even if the Navy does buy a variant of the Air Force's ATF, the Navy fighter might be more expensive than the Air Force fighter. The new F- 14D, for example, is projected to cost about twice as much as

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4. The procurement schedules for these two planes are good examples of the differences between Air Force and Navy classification policies. The Navy feels that its ATF schedule should be classified. And the entire Navy ATA program is a so-called "black program," which means among other things that its budget is accessible to only a very few people. The Air Force, on the other hand, has chosen to keep technical aspects of the ATF program--arguably the information of most use to the Soviet Union and for which the Congress has the least need--tightly held while providing the Congress with cost and scheduling information. These approaches appear to reflect Air Force and Navy policies rather than program sensitivity, since there appears to be no reason why cost and scheduling information should be more sensitive for either the Navy ATF or the ATA program than for Air Force variants.

5. The two services' requirements appear to be in direct conflict about whether the plane has a central load-carrying I-beam that would strengthen the plane's structure in the area where catapult takeoffs and arrested landings create the most stress. The Navy has indicated that it would prefer that the Air Force develop a plane with this beam down the center of the aircraft to facilitate conversion of the plane for carrier use. The Air Force may resist such a structural requirement, however, since it makes the plane heavier. Air Force and contractor sources have argued informally that a redesign incorporating the I-beam may not be too difficult. But such a modification of the weight-carrying structure of the aircraft might be viewed by some observers as being on the level of difficulty associated with adding a basement after a house is completed.

the Air Force's top-of-the-line F-15 fighter. This relationship in cost is caused not only by the heavier structure dictated by carrier operations, but also because of the demanding Navy mission of defending aircraft carriers. Therefore, this study has assumed that the cost ratio for the F-15 and the ATF will also hold for the F-14 and the Navy ATF.

HISTORICAL TRENDS IN THE COSTS OF NAVY AIRCRAFT

The Air Force estimates of the cost of the ATF exceed the cost of the Air Force F-15 aircraft by about 50 percent, though capability is supposed to increase by a much larger percentage. As noted above, one Navy source has indicated that the ATA would cost about the same as current Navy bombers, though former Secretary Lehman seemed to imply that the plane would cost 60 percent more than the A-6E.

All of these estimates are markedly lower than historical cost increases, in real terms, for Navy aircraft over previous equivalent aircraft.6/ Figure 6 shows the total average unit flyaway cost for each plane.7/ Flyaway costs for the A-6E, for example, are about 150 percent higher than those for the A-3, the Navy's heavy bomber in the 1950s. (Flyaway costs are a level of aggregation that exclude some procurement funding for items like spares and ground support equipment.) Moreover, the A-6E costs about 750 percent more than the A-1, a medium bomber that some analysts have described as the A-6's real predecessor.8/ The time period between the first A-1 and A-3 procurements and the first A-6E procurement is about comparable

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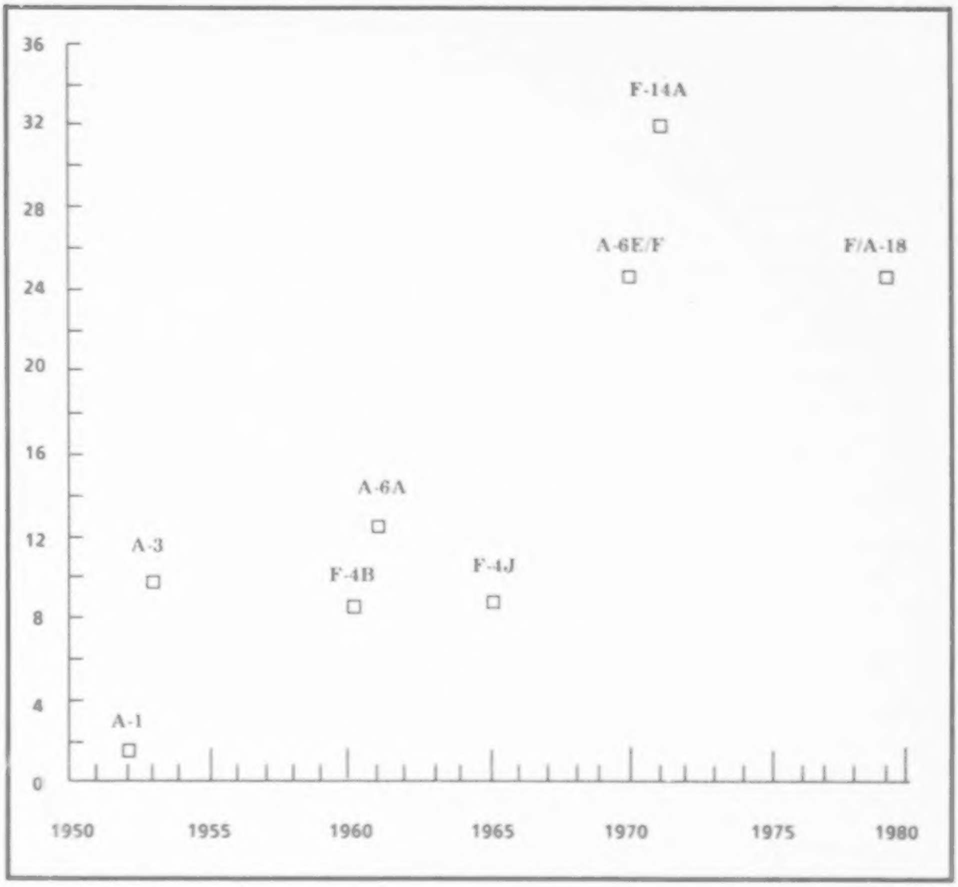
6. In fact, these estimates are lower than the cost increase associated with model changes for the A-6; costs of the E/F model were roughly double those of the A model. And the F-14's flyaway cost--defined as costs of the plane excluding support equipment and initial spares--is projected by the Navy to increase by about 60 percent when the plane's "D" model is produced.

7. Some analysts would argue that costs should be for equivalent units (for example, the two-hundredth unit built) rather than for average total units, since the total average favors planes with high procurement rates and large total quantities. Since cost often determines quantity, however, this measure was used.

8. Norman Friedman, *Carrier Air Power* (Greenwich, England: Conway Maritime Press, 1981), p. 75.

FIGURE 6. TOTAL AVERAGE UNIT FLYAWAY COSTS OF NAVY ATTACK AND FIGHTER AIRCRAFT, BY FIRST YEAR OF PROCUREMENT (In millions of 1988 dollars)



SOURCE: Congressional Budget Office estimates from data presented in Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983); and Selected Acquisition Reports to the Congress, various years.

to that between A-6E procurement and ATA procurement--roughly 20 years.

Attack aircraft are not alone in experiencing cost increases from generation to generation. The F-14, for example, costs about 260 percent more than its predecessor, the F-4. Even the F/A-18, designed to be a less capable cousin of the A-6 and F-14, is about 200 percent more expensive than the F-4. Cost growth between generations of aircraft is also experienced in other services. An earlier CBO study detailed similar results for Air Force aircraft.[9]

IMPACT OF COST AND OTHER FACTORS ON FORCE SIZE

The eventual cost of these two planes will have important effects on the Navy's ability to maintain and expand its forces. In order to assess these effects, the analysis projected the percentage of the Navy's fighter/attack requirements that it could buy by the year 2015--when ATAs and the Navy ATFs should be in the fleet in large numbers--as a function of cost and other factors. Requirements in the year 2015 were assumed to be equal to those in 1994, the last year for which Department of the Navy estimates are available.

Key Assumptions

Several key assumptions underlie the projections. Annual real growth of 3 percent above funds allocated in the 1987 budget for procurement of fighter/attack aircraft (that is, F-14s, A-6s, and F/A-18s) was assumed. Three percent approximates long-term historical growth in the gross national product (GNP) and so could indicate what would happen to defense spending, and thus perhaps to aircraft spending, if defense maintains its current share of GNP. It was also assumed that the Navy would maintain the current ratio among types of aircraft rather than shifting, say, to a mix richer in sophisticated and expensive planes. This assumption may be reasonable since it appears that the Navy plans a roughly one-for-one replacement of F-14s and A-6s with new aircraft.[10] Navy requirements for the three fighter/attack aircraft in the year 2015 are assumed to be about 1,860--the requirements associated with 14 active air wings, two reserve wings, and the Marine Corps' fighter and medium-attack forces in 1994. Finally, the study assumed that the Navy continues to buy the lower-cost aircraft now in production--the F/A-18--throughout this period. Consistent with experience with the F-14, however, improvements in the F/A-18 were assumed to add 3 percent a year to its real cost. Obviously, these assumptions are all highly uncertain. A later section discusses the effects of alternative values for some of these variables.

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[9] Congressional Budget Office, *Tactical Combat Forces of the United States Air Force.*

[10] Since new planes are typically expected to have much better capabilities than old ones, it might seem logical to assume that fewer of them would be needed. Improvements in capability, however, are frequently undertaken to "keep up" with projections of increases in qualitative or quantitative capability of the enemy.

Trends in Future Force Levels

The analysis suggests that, if actual events parallel the Navy's current assumptions, the service should be able to meet its requirements for aircraft with 3 percent annual budget growth. The Navy argues that it will keep current aircraft at least 25 years and that the ATA will cost roughly 60 percent more than the A-6. The Air Force expects its ATF to exceed the cost of its current F-15 aircraft by 50 percent, and this growth was assumed to apply to the Navy ATF in relation to the F-14. Under these assumptions, the Navy in the year 2015 should meet its requirements.[11] Specifically, it would meet 102 percent of them (see Table 11). Indeed, if some of the Navy's more optimistic estimates turn out to be true (the ATA costs no more than the A-6, planes remain in the inventory for 30 years), it could more than meet its requirements. Stated another way, there would be room for accommodating other sources of increases in costs or decreases in available funds.

On the other hand, as noted above, current Navy and Air Force estimates of increases in costs for the ATA and Navy ATF are much lower than those actually experienced between earlier generations of aircraft. If history is a guide, increases of factors of 2 to 3 are more realistic than increases of only about 1.5. Moreover, the Navy anticipates keeping both the F-14 and A-6 in the inventory between 25 years and 30 years. Though a few A-6 aircraft now exceed 25 years of age, the Navy has never kept large numbers of aircraft that long. For example, the Navy is currently retiring its F-4 fighter aircraft at around 19 years of service.

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11. The analysis assumes that procurement unit costs will increase by the same percentages as flyaway costs. Historical data for aircraft costs were available only at the flyaway level of aggregation. Should procurement costs increase at a different rate, the results of the analysis would be different.

If actual events parallel this history rather than the Navy's estimates, the Navy will not be able to meet its numerical requirements for aircraft. One set of assumptions consistent with cost history (increases of 2.5 in ATA costs over the costs of the A-6, and 2.8 in Navy ATF costs over costs of the F-14) allows the Navy to meet only 76 percent of its requirement in the year 2015, assuming current planes remain in the inventory until 25 years of age. That percentage drops

TABLE 11. PERCENTAGES OF FIGHTER/ATTACK REQUIREMENTS MET IN THE YEAR 2015, ASSUMING 3 PERCENT ANNUAL BUDGET GROWTH

		Cost Ratio of ATA to A-6		
Cost Ratio of Navy ATF to F-14	Aircraft Age at Retirement	1.0 (Lowest Navy estimate)	1.6 (Navy estimate)	2.5 (Cost Ratio of A-6E to A-3)
1.5 a/	30 years	125*	114*	102*
	25 years	112*	102*	90
	20 years	98	89	77
2.8 b/	30 years	104*	97	89
	25 years	92	85	76
	20 years	78	72	64
3.6 c/	30 years	96	90	83
	25 years	83	77	70
	20 years	69	64	58

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

NOTE: * = meets or exceeds Navy requirements.

a. Air Force estimate of the cost ratio of the ATF to the F-15.

b. Historical cost ratio of the F/A-18 to the F-4.

c. Historical cost ratio of the F 14 to the F-4.

to 64 percent if aircraft retire at 20 years, which may be more consistent with past experience.

Sensitivity to Assumptions

Results in Table 11 are quite sensitive to a variety of assumptions that are highly uncertain. While this sensitivity argues for great caution in using these results, there are as many plausible alternative assumptions that yield more pessimistic results as there are alternative assumptions that improve the chances of meeting Navy requirements.

Several alternative assumptions are analyzed in Table 12. The analysis chooses as a base case a selected group of assumptions--service estimates of cost growth (ATA to A-6 = 1.6, Navy ATF to F-14 = 1.5) and retirement at 25 years--and then varies them one at a time to indicate the sensitivity of the analysis. Several changes improve chances of meeting requirements, increasing the estimate of requirements met above 100 percent. These favorable assumptions include no growth in the real cost of the low-mix aircraft (the F/A-18), or a decrease in requirements back to levels consistent with 13 aircraft carriers and 12 air wings rather than the 15 carriers and 14 wings planned by the Navy.

Table 12 also shows several assumptions that would make it less likely that the Navy could meet its requirements. One assumption is that the Navy, in the face of improving Soviet capability, decides to retire aircraft after 15 years of service (an earlier Navy goal). Another is that ATA costs increase by a factor of 8.5 (equal to the ratio of A-6 costs to those of the A-1). This latter assumption implies that the ATA has a procurement unit cost of about $260 million in today's dollars. While this cost may seem ludicrous, it might have been regarded as equally ludicrous in 1950 to suggest that the A-6A would have a flyaway cost of $9.3 million apiece, or that the A-6E/F would have a flyaway cost of about $25 million when the Navy was buying the A-1 at a flyaway cost, in today's dollars, of only $1.5 million.

Alternative Assumptions about Budget Growth

Another key assumption concerns annual budget growth. The analysis in Tables 11 and 12 assumes 3 percent annual growth. As the earlier chapters on the Navy budget discuss, however, increases of 3 percent in the DoD budget over the long term may be unrealistic and are certainly higher than the negative real growth planned by the Congress over the next few years.

If real growth of 1 percent is assumed instead, Navy requirements would not be met in any of the cases considered, and substantial shortfalls could occur in several cases that are entirely plausible (see Table A-1 in the Appendix). Assumptions of this low growth might be consistent with growth in the economy well below historical norms, which constrains defense growth. Perhaps more realistically, such a

TABLE 12. PERCENTAGES OF FIGHTER/ATTACK AIRCRAFT REQUIREMENTS MET IN THE YEAR 2015 UNDER ALTERNATIVE ASSUMPTIONS

Base Case Assumptions a/	102
Base Case, except no growth in cost of low-mix aircraft (the F/A-18)	124
Base Case, except lower requirements (consistent with 13 carriers, 12 wings)	112
Base Case, except retirement at 15 years of age (Navy goal)	73
Base Case, except ATA costs 8.5 times A-6 (similar to cost ratio of A-6 to A-1)	52

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

a. Assumes Navy and Air Force estimates of cost growth (ATA to A-6 = 1.6, Navy ATF to F-14 = 1.5) and retirement at 25 years.

low percentage of growth in the Navy's budget for fighter and attack aircraft might be consistent with decisions to reallocate funds from the Navy aircraft procurement account to Navy ships or, perhaps, to other defense programs such as deployment of a comprehensive strategic defense system.

On the other hand, if funds available for fighter and attack aircraft grow by 5 percent a year in real terms, then the Navy could meet its requirements under a wide variety of assumptions (see Table A-2 in the Appendix). Indeed, with such growth the Navy would be close to meeting its requirements--at 94 percent--even if costs of its new aircraft grew in line with historical increases and if aircraft were retired after 20 years of service. Such large growth could be consistent with an increasing concern over threats to national security, which would lead to a larger share of U.S. gross national product being devoted to defense, and with a reallocation of funds within the Navy toward aircraft procurement, perhaps at the expense of ship procurement.

Indeed, since the Navy has already paid for the ships to expand its fleet to 600, it might seem plausible that the Navy could reallocate funds for shipbuilding and buy aircraft instead. A close look at when the Navy's carrier forces would retire, however, indicates that such a reallocation of funds to buy aircraft will not be likely in the foreseeable future. As shown in Table 13, eight carriers will reach retirement age in the first decade of the next century--even if they all receive service life extension programs (SLEPs), though only seven currently have SLEPs planned, and are retained until they are 45 years old. Because it takes seven or more years to build a carrier, the Navy would need to fund a new aircraft carrier roughly every 1.25 years over the next decade in order to maintain its aircraft carrier fleet into the next century. Given the priority accorded carriers by the Navy, this replacement schedule calls into question the Navy's willingness to allocate a larger share of the budget to aircraft.

Instead, might the Navy be able to temporarily reduce its operating and support (O&S) spending--largely funds for the Operation and Maintenance and Military Personnel accounts--to fund

TABLE 13. TIMING OF FUTURE BUDGETARY PRESSURES ASSOCIATED WITH REPLACEMENT OF AIRCRAFT CARRIERS

Carrier (Name/Number)	Year Commissioned	Extension Program (SLEP)	Likely Retirement Year a/	Year Carrier Authorized b/
Midway/41	1945	n.a.	1997 c/	1990 d/
Coral Sea/43	1947	n.a.	1992 c/	1983 d/
Forrestal/59	1955	1985	2000 e/	1992 e/
Saratoga/60	1956	1983	2001	1993
Ranger/61	1957	1993	2002	1994
Independence/62	1959	1987	2004	1996
Kitty Hawk/63	1961	1987	2006	1998
Constellation/64	1961	1991	2006	1998
Enterprise/65	1961	n.a.	2006 f/	1998
America/66	1965	1996	2010	2002
Kennedy/67	1968	2000	2013	2005
Nimitz/68	1975	n.a.	2020 f/	2012
Eisenhower/69	1977	n.a.	2022 f/	2014
Vinson/70	1982	n.a.	2027 f/	2019
Roosevelt/71	1986	n.a.	2031 f/	2023
Lincoln/72	1990	n.a.	2035 f/	2027
Washington/73	1992	n.a.	2037 f/	2029
74 g/	1997	n.a.	2042 f/	2034
75 g/	1999	n.a.	2044 f/	2036

SOURCE: Congressional Budget Office estimates using data from the Department of the Navy.

a. Retirement date = commissioning date + 45 years. (The Navy typically assumes a 45-year life only if a carrier has gone through SLEP. For simplicity, CBO has assumed 45 years for all carriers.)

b. The Navy typically assumes it needs an eight-year delay between carrier authorization and commissioning. Some long-lead funding would need to be budgeted even earlier.

c. The Midway and the Coral Sea will be retained for longer than 30 years even though they have never gone through SLEP. The Coral Sea will be replaced by the Washington in 1992, and CVN-74 will replace the Midway in 1997.

d. Authorization dates for CVN-74 and the Washington.

e. CVN-75 will replace a Forrestal-class carrier. If it replaces the oldest of the class--the Forrestal--then the replacement date would be 1999 and the authorization date would be 1993.

f. These retirement dates assume that these carriers will have 45-year lives even if no SLEP is planned.

g. Carriers 74 and 75 have not been named.

investment programs? Some analysts have argued that the Administration did exactly that during the 1980s, when operating funding dropped from 65 percent of the Navy's budget in 1980 to 53 percent by 1985.

On the other hand, there may be pressure for increases in operating funds as well, because of the relationship of those funds to the capital value of the items being operated. The ratio of the Navy's O&S costs on an annual basis to its capital value has remained fairly constant historically, varying by three percentage points from 1975 to 1987. Moreover, the capital value of major Navy weapons will grow for a number of years as weapons being purchased with current large budgets enter the fleet. Thus, should this relationship between O&S funds and capital stock continue in the future, the service may have less flexibility to decrease operating accounts than is commonly assumed.

CONGRESSIONAL ACTION

The analysis in this chapter suggests that it is critically important that the Navy develop its two new fighter/attack aircraft at costs close to current estimates. If it does not, the Navy may have great difficulty in meeting its numerical requirements for aircraft. Unfortunately, history provides little basis for assuming that costs of the aircraft will be held as low as current service estimates suggest. What, if anything, might the Congress do?

At this stage in the development of both planes, most efforts involve complex design considerations that the Congress would have difficulty monitoring. Indeed, some Members of Congress consider it undesirable to become involved in such detail.

The Congress could, however, place a cap on the costs of the two aircraft at the levels now estimated by the Navy. Subsequent Navy estimates that violate that cap would trigger more detailed Congressional review or even impoundment of development funds. The Congress took similar action in 1985 with regard to the Air Force's Advanced Tactical Fighter, when the Senate Committee on

Appropriations recommended a cap on that plane's costs of within 20 percent of the Air Force's development estimate.

Such caps, however, are difficult to specify and certainly difficult to monitor, since the procurement cost of a program can be hard to determine before procurement has begun. And monitoring a cap on ATA costs could prove particularly difficult given its classification level.

Nevertheless, the Congress may still wish to use a cap or some other mechanism to raise the priority accorded the task of monitoring the cost of these new aircraft.

APPENDIX

PERCENTAGES OF NAVY REQUIREMENTS MET IN THE YEAR 2015 UNDER VARIOUS ASSUMPTIONS

TABLE A-1. PERCENTAGES OF FIGHTER/ATTACK REQUIREMENTS MET IN THE YEAR 2015, ASSUMING 1 PERCENT ANNUAL BUDGET GROWTH

Cost Ratio of Navy ATF to F-14	Aircraft Age at Retirement	Cost Ratio of ATA to A-6		
		1.0 (Lowest Navy estimates)	1.6 (Navy estimates)	2.5 (Cost Ratio of A-6E to A-3)
1.5 a/	30 years	91	84	76
	25 years	79	72	64
	20 years	67	60	52
2.8 b/	30 years	78	73	67
	25 years	65	61	55
	20 years	53	49	44
3.6 c/	30 years	72	68	63
	25 years	60	56	51
	20 years	48	44	40

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

a. Air Force estimates of cost ratio of its Advanced Tactical Fighter to the F-15.

b. Historical cost ratio of F/A-18 to F-4.

c. Historical cost ratio of F-14 to F-4.

TABLE A-2. PERCENTAGES OF FIGHTER/ATTACK REQUIREMENTS MET IN THE YEAR 2015, ASSUMING 5 PERCENT ANNUAL BUDGET GROWTH

		Cost Ratio of ATA to A-6		
Cost Ratio of Navy ATF to F-14	Aircraft Age at Retirement	1.0 (Lowest Navy estimates)	1.6 (Navy estimates)	2.5 (Cost Ratio of A-6E to A-3)
1.5 a/	30 years	173*	158*	141*
	25 years	161*	146*	128*
	20 years	145*	131*	114*
2.8 b/	30 years	143*	133*	121*
	25 years	130*	120*	108*
	20 years	114*	105*	94
3.6 c/	30 years	130*	122*	112*
	25 years	117*	109*	99
	20 years	102*	94	85

SOURCE: Congressional Budget Office estimates using historical data from Management Consulting and Research, Inc., *The U.S. Military Aircraft Cost Handbook* (Falls Church, Va.: MCR, March 1983), and Selected Acquisition Reports to the Congress, various years; and Department of the Navy projections of future aircraft costs.

NOTE: * = meets or exceeds Navy requirements.

a. Air Force estimates of cost ratio of its Advanced Tactical Fighter to the F-15.

b. Historical cost ratio of the F/A-18 to the F-4.

c. Historical cost ratio of the F-14 to the F-4.

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